

CHILTON'S REPAIR & TUNE-UP GUIDE

TOYOTA PICK-UPS 1970-81

Hi-Lux • Half Ton • Long Bed • SR-5 • 4x4

55 WAYS
TO IMPROVE
FUEL ECONOMY



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CHILTON'S REPAIR & TUNE-UP GUIDE **TOYOTA** **PICK-UPS** **1970-81**

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SAFETY NOTICE

Proper service and repair procedures are vital to the safe, reliable operation of all motor vehicles, as well as the personal safety of those performing repairs. This book outlines procedures for servicing and repairing vehicles using safe, effective methods. The procedures contain many NOTES, CAUTIONS and WARNINGS which should be followed along with standard safety procedures to eliminate the possibility of personal injury or improper service which could damage the vehicle or compromise its safety.

It is important to note that repair procedures and techniques, tools and parts for servicing motor vehicles, as well as the skill and experience of the individual performing the work vary widely. It is not possible to anticipate all of the conceivable ways or conditions under which vehicles may be serviced, or to provide cautions as to all of the possible hazards that may result. Standard and accepted safety precautions and equipment should be used when handling toxic or flammable fluids, and safety goggles or other protection should be used during cutting, grinding, chiseling, prying, or any other process that can cause material removal or projectiles.

Some procedures require the use of tools specially designed for a specific purpose. Before substituting another tool or procedure, you must be completely satisfied that neither your personal safety, nor the performance of the vehicle will be endangered.

Although information in this guide is based on industry sources and is as complete as possible at the time of publication, the possibility exists that the manufacturer made later changes which could not be included here. While striving for total accuracy, Chilton Book Company cannot assume responsibility for any errors, changes, or omissions that may occur in the compilation of this data.

PART NUMBERS

Part numbers listed in this reference are not recommendations by Chilton for any product by brand name. They are references that can be used with interchange manuals and aftermarket supplier catalogs to locate each brand supplier's discrete part number.

ACKNOWLEDGMENTS

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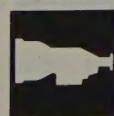
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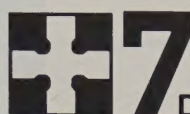
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Quick Reference Specifications For Your Vehicle

Fill in this chart with the most commonly used specifications for your vehicle. Specifications can be found in Chapters 1 through 3 or on the tune-up decal under the hood of the vehicle.



Tune-Up

Firing Order _____

Spark Plugs:

Type _____

Gap (in.) _____

Point Gap (in.) _____

Dwell Angle (°) _____

Ignition Timing (°) _____

Vacuum (Connected/Disconnected) _____

Valve Clearance (in.)

Intake _____

Exhaust _____



Capacities

Engine Oil (qts)

With Filter Change _____

Without Filter Change _____

Cooling System (qts) _____

Manual Transmission (pts) _____

Type _____

Automatic Transmission (pts) _____

Type _____

Front Differential (pts) _____

Type _____

Rear Differential (pts) _____

Type _____

Transfer Case (pts) _____

Type _____

FREQUENTLY REPLACED PARTS

Use these spaces to record the part numbers of frequently replaced parts.

PCV VALVE

OIL FILTER

AIR FILTER

Manufacturer _____

Manufacturer _____

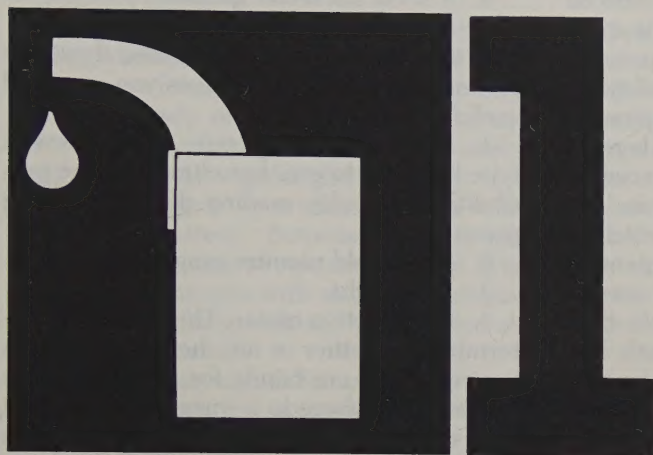
Manufacturer _____

Part No. _____

Part No. _____

Part No. _____

General Information and Maintenance



HOW TO USE THIS BOOK

Chilton's Repair & Tune-Up Guide for the Toyota Truck is intended to teach you more about the inner workings of your truck and save you money on its upkeep. The first two chapters will be used the most, since they contain maintenance and tune-up information and procedures. The following chapters concern themselves with the more complex systems of your truck. Operating systems from engine through brakes are covered to the extent that we feel the average do-it-yourselfer should get involved. This book will not explain such things as rebuilding the differential for the simple reason that the expertise required and the investment in special tools make this task uneconomical. We will tell you how to change your own brake pads and shoes, replace points and plugs, and many more jobs that will save you money, give you personal satisfaction, and help you avoid problems.

A secondary purpose of this book is as a reference for owners who want to understand their car and/or their mechanics better. In this case, no tools at all are required.

Before removing any parts, read through the entire procedure. This will give you the overall view of what tools and supplies will be required.

The sections begin with a brief discussion of the system and what it involves, followed by adjustments, maintenance, removal and installation procedures, and repair or overhaul procedures. When repair is not considered feasible, we tell you how to remove the part and then how to install the new or rebuilt replacement. In this way, you at least save the labor costs. Backyard repair of such components as the alternator is just not practical.

Two basic mechanic's rules should be mentioned here. One, whenever the left side of the truck or engine is referred to, it is meant to specify the driver's side of the truck. Conversely, the right side of the truck means the passenger's side. Secondly, most screws and bolts are removed by turning counterclockwise, and tightened by turning clockwise. Safety is always the most important rule. Constantly be aware of the dangers involved in working on an automobile and take the proper precautions. Use jackstands when working under a raised vehicle. Don't smoke or allow an exposed flame to come near the battery or any part of the fuel system. Always use the proper tool and use it correctly; bruised knuckles and skinned fingers aren't a mechanic's standard equipment. Always take your time and have patience; once you have some experience, working on your truck will become an enjoyable hobby.

2 GENERAL INFORMATION AND MAINTENANCE

TOOLS AND EQUIPMENT

It would be impossible to catalog each and every tool that you may need to perform all the operations included in this book. It would also not be wise for the amateur to rush out and buy an expensive set of tools on the theory that he may need one of them at some time. The best approach is to proceed slowly, gathering together a good quality set of those tools that are used most frequently. Don't be misled by the low cost of bargain tools. It is far better to spend a little more for quality, name brand tools. Forged wrenches, 10 or 12 point sockets and fine-tooth ratchets are by far preferable to their less expensive counterparts. As any good mechanic can tell you, there are few worse experiences than trying to work on a car or truck with bad tools. Your monetary savings will be far outweighed by frustration and mangled knuckles.

Begin accumulating those tools that are used most frequently; those associated with routine maintenance and tune-up. In addition to the normal assortment of screwdrivers and pliers, you should have the following tools for routine maintenance jobs:

1. Metric wrenches, sockets and combination open end/box end wrenches;
2. Jackstands—for support;
3. Oil filter wrench;
4. Oil filler spout or funnel;
5. Grease gun—for chassis lubrication;
6. Hydrometer—for checking the battery;
7. A low flat pan for draining oil;
8. Lots of rags for wiping up the inevitable mess.

In addition to the above items, there are several others that are not absolutely necessary, but are handy to have around. These include oil drying compound, a transmission funnel, and the usual supply of lubricants, antifreeze and fluids, although these can be purchased as needed. This is a basic list for routine maintenance, but only your personal needs can accurately determine your list of tools.

The second list of tools is for tune-ups. While the tools involved here are slightly more sophisticated, they need not be outrageously expensive. There are several inexpensive tach/dwell meters on the market that are every bit as good for the average mechanic as a \$100.00 professional model. Just be sure that it goes to at least 1200–1500 rpm on the tach scale, and that it works on 4, 6,

and 8 cylinder engines. A basic list of tune-up equipment could include:

1. Tach/dwell meter;
2. Spark plug wrench;
3. Timing light (preferably a DC light that works from the truck battery);
4. A set of flat feeler gauges;
5. A set of round wire spark plug gauges.

In addition to these basic tools, there are several other tools and gauges you may find useful. These include:

1. A compression gauge. The screw-in type is slower to use, but eliminates the possibility of a faulty reading due to escaping pressure;
2. A manifold vacuum gauge;
3. A test light;
4. An induction meter. This is used for determining whether or not there is current in a wire. These are handy for use if a wire is broken somewhere in a wiring harness. As a final note, you will probably find a torque wrench necessary for all but the most basic work. The beam type models are perfectly adequate, although the newer click type are more precise.

Special Tools

Normally, the use of special factory tools is avoided for repair procedures, since these are not readily available for the do-it-yourself mechanic. When it is possible to perform the job with more commonly available tools, it will be pointed out, but occasionally, a special tool was designed to perform a specific function and should be used. Before substituting another tool, you should be convinced that neither your safety nor the performance of the vehicle will be compromised.

Some special tools are available commercially from major tool manufacturers. Others for your Toyota can be purchased from your dealer or from Owatonna Tool Co., Owatonna, Minnesota 55060.

SERVICING YOUR VEHICLE SAFELY

It is virtually impossible to anticipate all of the hazards involved with automotive maintenance and service but care and common sense will prevent most accidents.

The rules of safety for mechanics range from "don't smoke around gasoline," to "use the proper tool for the job." The trick to

avoiding injuries is to develop safe work habits and take every possible precaution.

Do's

- Do keep a fire extinguisher and first aid kit within easy reach.

- Do wear safety glasses or goggles when cutting, drilling, grinding or prying. If you wear glasses for the sake of vision, then they should be made of hardened glass that can serve also as safety glasses, or wear safety goggles over your regular glasses.

- Do shield your eyes whenever you work around the battery. Batteries contain sulphuric acid; in case of contact with the eyes or skin, flush the area with water or a mixture of water and baking soda and get medical attention immediately.

- Do use safety stands for any under-truck service. Jacks are for raising vehicles; safety stands are for making sure the vehicle stays raised until you want it to come down. Whenever the vehicle is raised, block the wheels remaining on the ground and set the parking brake.

- Do use adequate ventilation when working with any chemicals. Asbestos dust resulting from brake lining wear can cause cancer.

- Do disconnect the negative battery cable when working on the electrical system. The primary ignition system can contain up to 40,000 volts.

- Do follow manufacturer's directions whenever working with potentially hazardous materials. Both brake fluid and antifreeze are poisonous if taken internally.

- Do properly maintain your tools. Loose hammerheads, mushroomed punches and chisels, frayed or poorly grounded electrical cords, excessively worn screwdrivers, spread wrenches (open end), cracked sockets, slipping ratchets, or faulty droplight sockets can cause accidents.

- Do use the proper size and type of tool for the job being done.

- Do when possible, pull on a wrench handle rather than push on it, and adjust your stance to prevent a fall.

- Do be sure that adjustable wrenches are tightly adjusted on the nut or bolt and pulled so that the face is on the side of the fixed jaw.

- Do select a wrench or socket that fits the nut or bolt. The wrench or socket should sit straight, not cocked.

- Do strike squarely with a hammer avoid glancing blows.

- Do set the parking brake and block the drive wheels if the work requires that the engine be running.

Dont's

- Don't run an engine in a garage or anywhere else without proper ventilation—EVER! Carbon monoxide is poisonous; it is absorbed by the body 400 times faster than oxygen; it takes a long time to leave the human body and you can build up a deadly supply of it in your system by simply breathing in a little every day. You may not realize you are slowly poisoning yourself. Always use power vents, windows, fans or open the garage doors.

- Don't work around moving parts while wearing a necktie or other loose clothing. Short sleeves are much safer than long, loose sleeves. Hard-toed shoes with neoprene soles protect your toes and give a better grip on slippery surfaces. Jewelry such as watches, fancy belt buckles, beads or body adornment of any kind is not safe working around a car. Long hair should be hidden under a hat or cap.

- Don't use pockets for toolboxes. A fall or bump can drive a screwdriver deep into your body. Even a wiping cloth hanging from the back pocket can wrap around a spinning shaft or fan.

- Don't smoke when working around gasoline, cleaning solvent or other flammable material.

- Don't smoke when working around the battery. When the battery is being charged, it gives off explosive hydrogen gas.

- Don't use gasoline to wash your hands; there are excellent soaps available. Gasoline may contain lead, and lead can enter the body through a cut, accumulating in the body until you are very ill. Gasoline also removes all the natural oils from the skin so that bone dry hands will absorb oil and grease.

- Don't service the air conditioning system unless you are equipped with the necessary tools and training. The refrigerant, R-12, is extremely cold and when exposed to the air, will instantly freeze any surface it comes in contact with, including your eyes. Although the refrigerant is normally non-toxic, R-12 becomes a deadly poisonous gas in the presence of an open flame. One good whiff of the vapors from burning refrigerant can be fatal.

HISTORY

The Toyota Pick-Up is the refinement of a light-duty, multi-purpose vehicle, manufactured by the world's third largest producer of commercial vehicles, the Toyota Motor Company. It is a rugged, but comfortable, half-ton truck which easily doubles as around-town transportation.

In 1933 the Toyoda Automatic Loom Works started an automobile division. Serious automobile production did not begin until 1937, when the Toyota Motor Co., Ltd. was founded. A numerologist suggested changing the family name Toyoda, to Toyota because it was favored in this type of endeavor. The numerologist must have been right because by 1947 Toyota had produced 100,000 vehicles. Today the Toyota Motor Co. is Japan's largest automotive manufacturer.

Toyotas were not imported until the late 1950s and Americans were generally not impressed by the heavy, underpowered cars. Toyota scored a major breakthrough in the American economy in 1965 with the introduction of the Corona sedan.

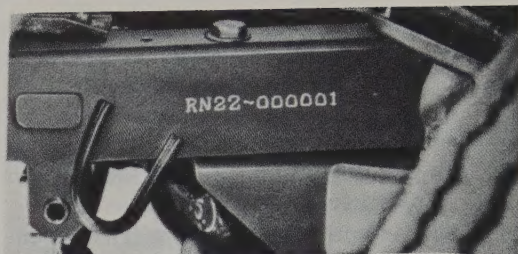
The earliest recollection of a Toyota pick-up truck being imported to this country is around 1966. It was called a Stout and was powered by a 1900 cc overhead valve engine. Though popular in some parts of the country for its work-horse characteristics, it never enjoyed the popularity of the Hi-Lux, introduced in 1970.

The Hi-Lux, originally available in one size with the 8R-C engine, soon received a larger engine, a Long Bed variant, front disc brakes, automatic transmission, and various optional equipment, including air conditioning. In 1975, the 20R engine was introduced, along with the SR-5 sport truck with the five speed overdrive transmission. The Toyota pick-up is now available in Standard Bed, Long Bed, and SR-5 versions, the SR-5 coming with either bed. It continues to offer one of the most powerful engines in its class and traditional Toyota value per dollar.

SERIAL NUMBER IDENTIFICATION

Vehicle

The vehicle serial number is stamped on the left-side of the frame behind the front wheel.



Vehicle serial number location

It consists of a four-digit model number and a six-digit production number.

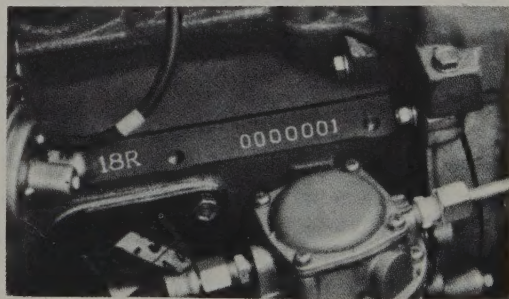
Engine

The engine serial number consists of an engine series identification number followed by a six-digit production number.

On 1900 cc engines, the model number is 8R-C and the serial number is stamped on the right-side of the engine block beside the fuel pump.

The 2000 cc model 18R-C engine has its serial number stamped on the left-side of the engine below the number one spark plug.

On later engines the serial number is stamped on the left side of the cylinder block, behind the alternator.



Engine serial number location—18R-C engine

ROUTINE MAINTENANCE

Air Cleaner

The paper element of the air filter assembly should be blown clean with compressed air every 6 months or 6,000 miles under normal driving conditions. For 1970-78 the filter element should be changed every 24,000 miles. 1979-81 filters should be changed every 30,000 miles. Advance the cleaning and replacement schedule when the vehicle is operated in dusty areas.

To remove the paper element, unscrew

Vehicle and Engine Identification

Model	Series Identifi- cation Number	Engine Series Identifi- cation	Displace- ment Cu in. (cc)	Number of Cylin- ders	Type	Carbu- retor	Year
Hi-Lux	RN12	8R-C	113.4 (1858)	4	OHC	2 bbl	1970-71
Hi-Lux	RN14	18R-C	120.1 (1968)	4	OHC	2 bbl	1971-72
Standard Bed Long Bed	RN22 RN27	18R-C	120.1 (1968)	4	OHC	2 bbl	1972-74
Standard Bed Long Bed	RN23 RN28	20R	133.6 (2189)	4	OHC	2 bbl	1975-77
Standard Bed Long Bed	RN30 RN40	20R	133.6 (2189)	4	OHC	2 bbl	1978
Standard Bed Long Bed	RN36 RN46	20R	133.6 (2189)	4	OHC	2 bbl	1979
Standard Bed Long Bed	RN37 RN47	20R	133.6 (2189)	4	OHC	2 bbl	1979
Standard Bed Long Bed	RN32L RN42L	20R	133.6 (2189)	4	OHC	2 bbl	1980
Standard Bed Long Bed	RN37L RN47L	20R	133.6 (2189)	4	OHC	2 bbl	1980
Standard Bed Long Bed		22R	144.4 (2367)	4	OHC	2 bbl	1981

the wing nut on the air filter assembly and unlatch the clamps securing the cover. Make sure that the gaskets on the case and cover are in place before reassembling. 20R engines have a hose connected to the top cover. This will have to be disconnected before removing the cover. After removing the paper element, wipe out the cover and case with a soft rag to remove any accumulated dust. Match up the arrows on the cover and case when reassembling.

NOTE: Do not operate the engine without the air filter element in place.

PCV Valve

The operation of the positive crankcase ventilation system should be checked every 12,000 miles. To do this remove the hose from the valve located at the top of the valve cover. Remove the valve and shake it. If it rattles, it's okay. If not, replace it. Wash the

valve with kerosene or other suitable solvent and blow clean with compressed air. Clean the hose which goes from the valve to the intake manifold by running a solvent-soaked rag through the hose. If it shows signs of wear, replace it with a hose of equal quality.

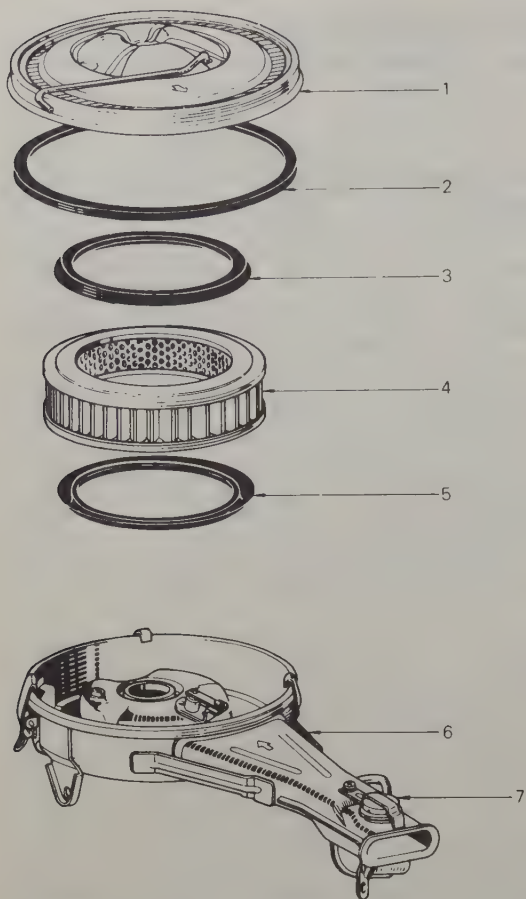
Replace the PCV valve every 12,000 miles for 1970-78 and 30,000 miles for 1979 and later.

NOTE: The PCV system will not function properly unless the oil filler cap is tightly sealed. Check the gasket on the cap and be certain it is not leaking. Replace the cap or gasket or both if necessary to ensure proper sealing.

Evaporative Emission Control Canister

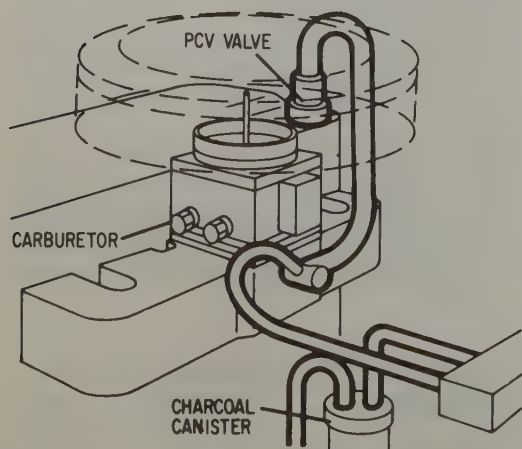
There is no charcoal canister for 8R-C engines (1970-71). It can be found on the front of the left fender on 18R-C engine trucks, late 1971 through 1974, and at the rear of the

6 GENERAL INFORMATION AND MAINTENANCE



- | | |
|--------------------|-----------------------------|
| 1. Cover | 5. Gasket |
| 2. Gasket | 6. Case |
| 3. Gasket | 7. Hot air intake diaphragm |
| 4. Cleaner element | |

20R air cleaner element and case. Other models are similar. Check the gasket for a tight seal before replacing the cover



Typical PCV valve and Charcoal Canister installation. On 20R engines, the PCV valve is under the second hose, in the center of the valve cover

engine compartment, on or near the firewall on 1975 and later trucks.

Clean and inspect the canister for damage every 12,000 miles, (1970–78), 30,000 miles (1979 and later). Every 50,000 miles it should be replaced (1970–78). It is not necessary to replace this canister on 1979 and later models.

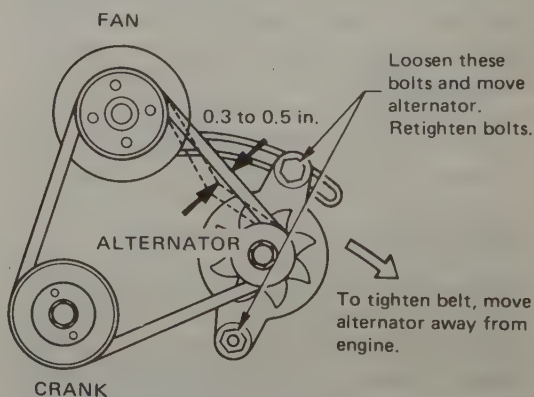
8R-C Case Storage System

1970–71 trucks equipped with the 8R-C engine use a case storage system in lieu of the charcoal canister. This system's basic function is to prevent the escape of fuel vapors by routing them into a storage case for later combustion. The only scheduled maintenance for this system is the replacement of the system's air filter every 12,000 miles. The filter is located above the fuel vapor storage case, next to the fuel filler cap. Unplug the old filter from the hose, discard it, and insert the new filter.

Drive Belts

The fan belt should be checked for cracks and wear periodically, and especially before going on any long distance trip. Check the belt tension regularly in the following manner. Depress the belt midway between the fan and alternator pulleys. The belt should have about $\frac{1}{8}$ in. to $\frac{1}{2}$ in. slack. If the belt is too loose, tighten it by loosening the alternator bracket bolt and the bolt on the adjusting bar; then, using a long piece of wood or a hammer handle, pry the alternator away from the engine until the proper tension is achieved.

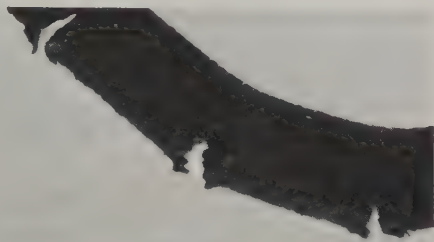
CAUTION: Do not use a screwdriver or other metal device to pry the alternator as damage to the alternator may result.



Fan belt adjustment

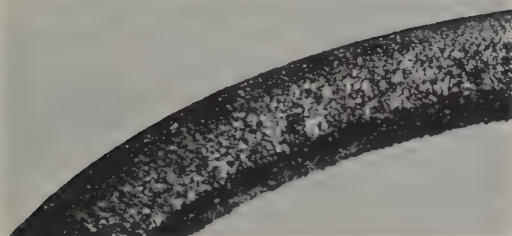
How to Spot Worn V-Belts

V-Belts are vital to efficient engine operation—they drive the fan, water pump and other accessories. They require little maintenance (occasional tightening) but they will not last forever. Slipping or failure of the V-belt will lead to overheating. If your V-belt looks like any of these, it should be replaced.



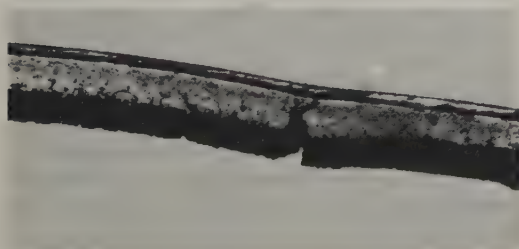
Cracking or weathering

This belt has deep cracks, which cause it to flex. Too much flexing leads to heat build-up and premature failure. These cracks can be caused by using the belt on a pulley that is too small. Notched belts are available for small diameter pulleys.



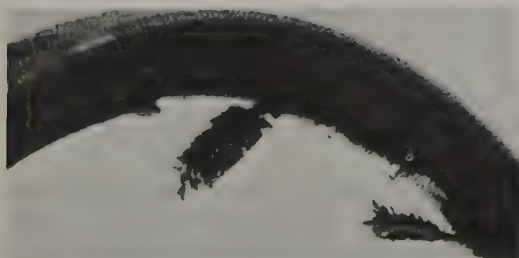
Softening (grease and oil)

Oil and grease on a belt can cause the belt's rubber compounds to soften and separate from the reinforcing cords that hold the belt together. The belt will first slip, then finally fail altogether.



Glazing

Glazing is caused by a belt that is slipping. A slipping belt can cause a run-down battery, erratic power steering, overheating or poor accessory performance. The more the belt slips, the more glazing will be built up on the surface of the belt. The more the belt is glazed, the more it will slip. If the glazing is light, tighten the belt.



Worn cover

The cover of this belt is worn off and is peeling away. The reinforcing cords will begin to wear and the belt will shortly break. When the belt cover wears in spots or has a rough jagged appearance, check the pulley grooves for roughness.



Separation

This belt is on the verge of breaking and leaving you stranded. The layers of the belt are separating and the reinforcing cords are exposed. It's just a matter of time before it breaks completely.

8 GENERAL INFORMATION AND MAINTENANCE

How to Spot Bad Hoses

Both the upper and lower radiator hoses are called upon to perform difficult jobs in an inhospitable environment. They are subject to nearly 18 psi at under hood temperatures often over 280°F., and must circulate nearly 7500 gallons of coolant an hour—3 good reasons to have good hoses.



Swollen hose

A good test for any hose is to feel it for soft or spongy spots. Frequently these will appear as swollen areas of the hose. The most likely cause is oil soaking. This hose could burst at any time, when hot or under pressure.



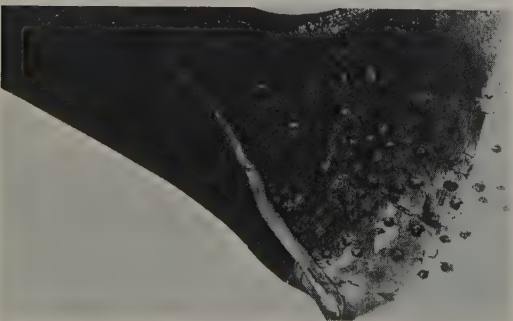
Cracked hose

Cracked hoses can usually be seen but feel the hoses to be sure they have not hardened; a prime cause of cracking. This hose has cracked down to the reinforcing cords and could split at any of the cracks.



Frayed hose end (due to weak clamp)

Weakened clamps frequently are the cause of hose and cooling system failure. The connection between the pipe and hose has deteriorated enough to allow coolant to escape when the engine is hot.



Debris in cooling system

Debris, rust and scale in the cooling system can cause the inside of a hose to weaken. This can usually be felt on the outside of the hose as soft or thinner areas.

Tighten the alternator and adjusting bar bolts securely. If a new belt is installed, the tension should be checked again after about 1,000 miles of operation.

Belt adjustments for the air pump and air conditioning compressor are made in the same way. Be careful not to pry against the cast housing of the air pump, as it is brittle and subject to breakage.

Be certain when making these adjustments not to overtighten. Overtight drive belts will lead to bearing failure.

Air Conditioning System Check

CAUTION: Do not attempt to charge or discharge the refrigerant system unless you are thoroughly familiar with its operation and the hazards involved. The compressed refrigerant used in the air conditioning system expands and evaporates (boils) into the atmosphere at a temperature of -21.7°F (-29.8°C) or less. This will freeze any surface, including your eyes, that it contacts. In addition, the refrigerant decomposes into a poisonous gas in the presence of flame.

Toyota units have a sight glass for checking the refrigerant charge. This is on top of the receiver dehydrator, alongside the radiator.

NOTE: If your truck is equipped with an aftermarket air conditioner, the following system check may not apply. You should contact the manufacturer of your unit for instructions on system checks.

1. Start the engine and set it on fast idle.
2. Set the controls for maximum cold with the blower on high.
3. If bubbles are present in the sight glass, the system is low on charge. If no bubbles are present, the system is either fully charged or empty.
4. Feel the high and low pressure lines at the compressor. The high pressure line

should be warm and the low pressure line should be cool. If no appreciable temperature difference is felt, the system is empty, or nearly so.

Even if there is a noticeable temperature difference, there is a possibility of overcharge. Disconnect the compressor clutch wire. If the refrigerant in the sight glass remains clear for more than 45–60 seconds before foaming and then settling away from the sight glass, an overcharge is indicated. If the refrigerant foams and then settles away from the sight glass in less than 45–60 seconds, it can be assumed that the system is properly charged.

The air conditioning system should be operated for about five minutes each week, even in winter. This will circulate lubricating oil within the system to prevent the various seals from drying out.

Windshield Wipers

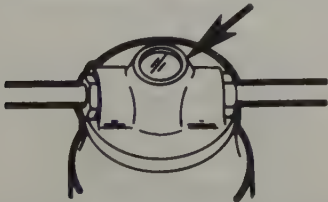
Intense heat from the sun, snow and ice, road oils and the chemicals used in windshield washer solvents combine to deteriorate the rubber wiper refills. The refills should be replaced about twice a year or whenever the blades begin to streak or chatter.

WIPER REFILL REPLACEMENT

Normally, if the wipers are not cleaning the windshield properly, only the refill has to be replaced. The blade and arm usually require replacement only in the event of damage. It is not necessary (except on new Tridon refills) to remove the arm or the blade to replace the refill (rubber part), though you may have to position the arm higher on the glass. You can do this turning the ignition switch on and operating the wipers. When they are positioned where they are accessible, turn the ignition switch off.

There are several types of refills and your vehicle could have any kind, since aftermarket blades and arms may not use exactly the same refill as the original equipment.

Most Trico styles use a release button that is pushed down to allow the refill to slide out of the yoke jaws. The new refill slides in and locks in place. Some Trico refills are removed by locating where the metal backing strip or the refill is wider. Insert a small screwdriver blade between the frame and metal backing strip. Press down to release the refill from the retaining tab.



Arrow points to the sight glass on top of the air conditioner's receiver dehydrator, located next to the radiator. Although the sight glass is very small, any bubbles in the refrigerant should be readily apparent in strong light

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The Anco style is unlocked at one end by squeezing 2 metal tabs, and the refill is slid out of the frame jaws. When the new refill is installed, the tabs will click into place, locking the refill.

The polycarbonate type is held in place by a locking level that is pushed downward out of the groove in the arm to free the refill. When the new refill is installed, it will lock in place automatically.

The Tridon refill has a plastic backing strip with a notch about an inch from the end. Hold the blade (frame) on a hard surface so that the frame is tightly bowed. Grip the tip of the backing strip and pull up while twisting counterclockwise. The backing strip will snap out of the retaining tab. Do this for the remaining tabs until the refill is free of the arm. The length of these refills is molded into the end and they should be replaced with identical types.

No matter which type of refill you use, be sure that all of the frame claws engage the refill. Before operating the wipers, be sure that no part of the metal frame is contacting the windshield.

Fluid Level Checks

ENGINE OIL

The oil level in the engine should be checked as the last step in a fuel stop. The check should be made with the engine warm and switched off for a period of about one minute so that the oil can drain down into the crankcase. Pull out the dipstick, wipe it clean, and reinsert it. The level of the oil should be kept between the minimum and maximum marks at all times. If the oil level is kept above the maximum mark, heavy oil consumption will result. If the level remains below the mini-

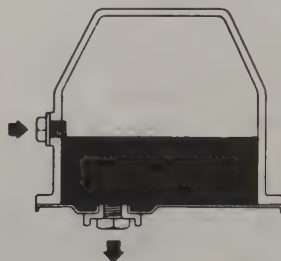


Oil filler cap and dipstick location

mum mark, severe engine damage will result. When topping off the crankcase oil be sure to add oil of the same viscosity rating as the oil in the crankcase.

MANUAL TRANSMISSION FLUID

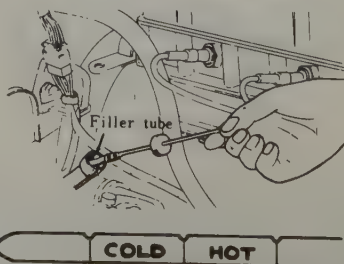
Park the truck on level ground and using a 17 mm wrench, loosen the filler plug. The lubricating oil should reach the bottom of the filler plug hole. If it does not, fill to the proper level with SAE 90 weight gear oil meeting the API service GL-4 specification. Perform this check every 6 months or 7500 miles.



Oil level should reach the bottom of the filler plug hole in the manual transmission

AUTOMATIC TRANSMISSION FLUID

It is best to check the fluid level of an automatic transmission when the engine and transmission are warm. A transmission is warm after it has been driven 6 or 7 miles. Park the truck on level ground and set the parking brake firmly. Shift the transmission through all gear ranges at idle speed. Use the transmission dipstick to check the fluid level with the transmission in the Neutral range. Pull the dipstick, wipe it clean, reinsert it, making sure it is fully seated, then pull it out again and check the level of the fluid. It should be within the Hot range marked on the dipstick. If additional fluid is required, add Type F fluid only through the dipstick tube. Stop and check the fluid level frequently as you add; overfilling will cause foaming, fluid loss, and slippage.



Checking automatic transmission fluid level

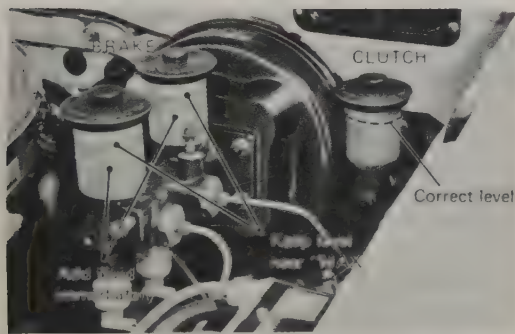
BRAKE AND CLUTCH MASTER CYLINDER

The translucent reservoirs must be kept $\frac{3}{4}$ full at all times. It is best to check the level weekly. When adding fluid take care to prevent foreign material from entering the cylinder. Use DOT 3 classification brake fluid.

NOTE: *It is normal for the fluid level to fall as the disc brake pads wear. However, if the master cylinder requires filling frequently, you should check the system for leaks in the hoses, master cylinder, or wheel cylinders.*

CAUTION: *Brake fluid dissolves paint. It also absorbs moisture from the air; never leave a container or the master cylinder or the clutch cylinder uncovered any longer than necessary.*

The clutch master cylinder uses the same fluid as the brakes, and should be checked at the same time as the brake master cylinder.



Brake and clutch master cylinder reservoirs

COOLING SYSTEM

Dealing with the cooling system can be a dangerous matter unless the proper precautions are exercised. It is best to check the coolant level in the radiator when the engine is cold by simply removing the radiator cap and seeing that the coolant reaches the bottom of the filler neck. On newer trucks the cooling system has, as one of its components, an expansion tank in which case the radiator cap need not be removed if coolant is visible in the expansion reservoir. Always make certain that the filler caps on both the radiator and the reservoir are tightly closed.

In the event that you must check the coolant level when the engine is warm, proceed in this manner: place a thick rag over the radiator cap and slowly turn the cap to the dent. This will allow the pressure to drop gradually, preventing an explosion of hot



Radiator cap and coolant reservoir

coolant. When the steam has escaped, remove the cap the rest of the way.

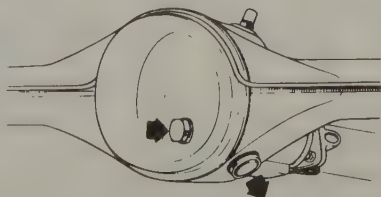
CAUTION: *When adding cold coolant to a hot radiator, always do so with the engine running.*

If the coolant level is low, add equal amounts of anti-freeze and clean water. On models without an expansion tank, add coolant through the radiator filler neck. Add coolant to the recovery tank on trucks equipped with that system.

If the coolant level is chronically low, refer to the "Troubleshooting" Chapter for diagnosis of the problem. Refer to Chapter Three for coolant draining and refilling, which should be done every 24 months or 24,000 miles for 1970-78, and 24 months or 30,000 miles on 1979 and later.

REAR AXLE

The lubricant in the differential housing must reach the bottom of the filler plug hole. To see if it does, remove the filler plug with a 24 mm wrench and use your finger to check the level. If you must add fluid it should be SAE 90 weight gear oil meeting the API service GL-5 classification. If the truck is to be operated in temperatures under -10°F (-23°C), use SAE 80W or 85W GL-5 gear oil. You should check the fluid level every 6 months or 6,000 miles.



Position of the differential fill and drain plugs

STEERING GEAR

Every year you should check the steering gear housing lubricating oil. The housing

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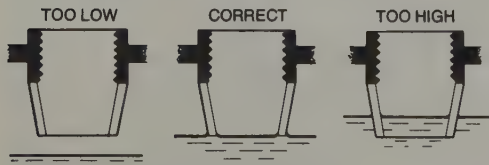
should be full of SAE 90 weight gear oil meeting API service GL-4 classification. The filler plug is on top of the housing and requires a 14 mm wrench for removal.

BATTERY ELECTROLYTE

At every fuel stop the level of the battery electrolyte should be checked. The level should be maintained between the upper and lower levels marked on the battery case or the bottom of the vent well in each cell.

If the electrolyte level is low, distilled water should be added until the proper level is reached. Each cell is completely separate from the others, so each must be filled individually. It is a good idea to add the distilled water with a squeeze bulb to avoid having electrolyte splash out. If water is frequently needed, the most likely cause is overcharging, caused by a faulty voltage regulator. If any acid solution should escape, it can be neutralized with a baking soda and water solution, but don't let the stuff get in the battery. In winter, add water only before driving to prevent the battery from freezing and cracking. When replacing a battery, it is important that the replacement have an output rating equal to or greater than original equipment. See Chapter Three for details on battery replacement.

CAUTION: *If you get acid on your skin or in your eyes, rinse it off immediately with lots of water. Go to a doctor if it gets in your eyes. The gases formed inside the battery cells are highly explosive. Never check the level of the electrolyte in the presence of flame or while smoking.*



Black battery case fluid level

Tires

The importance of proper tire inflation cannot be overemphasized. A tire employs air under pressure as part of its structure. It is

designed around the supporting strength of a gas at a specified pressure. For this reason improper inflation drastically reduces the tire's ability to perform as it was intended. Tire pressures should be checked regularly with a reliable pressure gauge. Too often the gauge on the end of the air hose at your corner garage is not accurate enough because it suffers too much abuse.

Always check tire pressure when the tires are cold, as pressure increases with temperature. If you must move the vehicle to check the tire inflation, do not drive more than a mile before checking. A cold tire is one that has not been driven on for a period of about three hours.

CAUTION: *Never exceed the maximum tire pressure marked on the tire.*

When buying new tires, you should keep the following points in mind, especially if you are switching to larger tires or a different profile series (50, 60, 70, 78):

1. All four tires should be of the same construction type. Radial, bias, or bias-belted tires should not be mixed.

2. The wheels must be the correct width for the tire. Tire dealers have charts of tire and wheel rim compatibility. A mismatch can cause sloppy handling and rapid tread wear. The tread width should match the rim width (inside bead to inside bead) within an inch. For radial tires, the rim width should be 80% or less of the tire (not tread) width.

3. The height (mounted diameter) of the new tires can change speedometer accuracy, engine speed per given road speed, fuel mileage, acceleration, and ground clearance. Tire manufacturers furnish full measurement specifications.

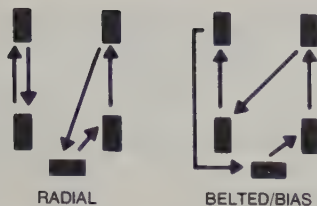
4. The spare tire should be usable, at least for low speed operation, with the new tires.

5. There shouldn't be any body interference when the truck is loaded, on bumps or in turning.

TIRE ROTATION

So that the tires wear more uniformly, it is recommended that the tires be rotated every 6,000 miles. This can be done when all four tires are of the same size and load rating capacity.

If your truck is equipped with 6 ply tires on the rear they should not be mounted on the front of the vehicle if the front tires are 4 ply rated. This is the case with some of the newer models. Also, some long bed models use 7.50 x 14 tires on the rear; these should



These patterns should be followed when rotating tires; however, the spare tire can be bypassed, if desired

not be mounted on the front of the truck. Any abnormal tire wear should be investigated and the cause corrected.

Radial tires should not be cross-switched; they'll last longer if their direction of rotation is not changed. Truck-type tires sometimes have directional tread, indicated by arrows molded into the sidewalls; the arrow shows the direction of rotation. They will wear very rapidly if reversed. Studded snow tires will lose their studs if their direction of rotation is reversed.

NOTE: Mark the wheel position or direction of rotation on radial tires or studded snow tires before removal.

CAUTION: Avoid overtightening the lug nuts or the brake disc or drum may become permanently distorted. Alloy wheels can be cracked by overtightening. Always tighten the nuts in a crisscross pattern.

Tire Size and Inflation Chart

Model	Tire Size	Rating	Cold Tire Pressure
RN 12, 14	6.00-14	6 ply	f. 24 r. 28
RN 22 front	7.00-14	4 ply	24
RN 22 rear	7.00-14	6 ply	28
RN 27 front	7.00-14	4 ply	24
RN 27 rear	7.50-14	6 ply	28
RN 23	7.00-14	6 ply	See label
RN 28	7.00-14	6 ply	on driver's
SR-5	185SR-14	4 ply	door edge.

f. front
r. rear

Fuel Filter Replacement

All models have a fuel filter located in the engine compartment. RN12s (1970-71 Hi-Lux) with the 8R-C engine use a replaceable cartridge type filter located in the fuel line before it reaches the fuel pump. Only the filter element itself is changed on this type. All other trucks use a disposable filter which is replaced as a unit at the specified interval.

The fuel filter on all models is located on the right fender well.

8R-C ENGINES

It is not necessary to remove the filter unit to replace the element.

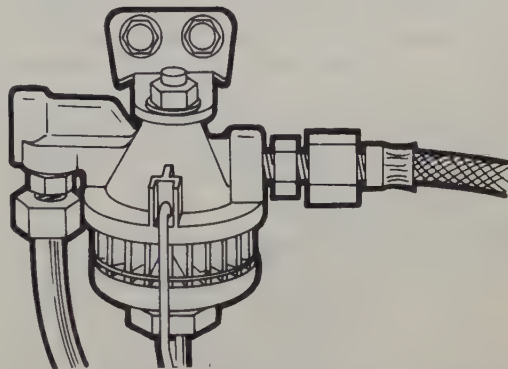
1. Loosen and remove the nut on the filter bowl bail.

2. Take out the bowl, element spring, element, and bowl gasket.

3. Wash the parts (except for the element—discard that) in solvent and inspect for damage. Install a new filter element, and if its condition warrants, a new gasket.

4. After reinstalling the parts, do not fully tighten the bail nut.

5. Seat the bowl by turning it slightly, pressing gently against the gasket. Tighten the bail nut fully and check for leaks.

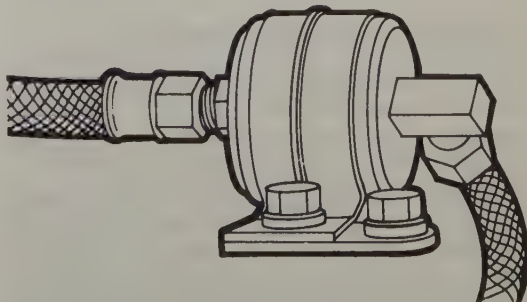


Only the bottom nut need be unbolted on the 8R-C fuel filter

18R-C ENGINES

The entire fuel filter is replaced on these engines.

1. Unfasten the fuel intake hose. Use a wrench to loosen the attachment nut, and an-



The fuel filter on 18R-C engines will either have two nuts, as illustrated here, or a nut on one side and a clamp on the other. Be sure you get the correct replacement filter for your truck

other wrench on the opposite side to keep the filter from turning.

2. Remove the flexible fuel line from the other side of the filter. Unfasten the attaching screws from the filter bracket.

3. Install the new filter and reconnect the fuel lines. Start the engine and check for leaks.

20R AND 22R ENGINES

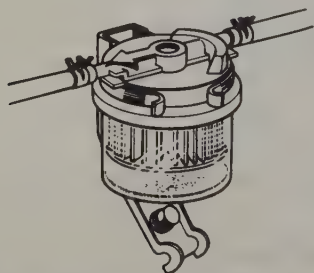
The entire fuel filter is replaced on these engines.

1. Using a pair of pliers, expand the hose clamp on one side of the filter, and slide the clamp further down the hose, past the point to which the filter pipe extends. Remove the other clamp in the same manner.

2. Grasp the hoses near the ends and twist them gently to pull them free from the filter pipes.

3. Pull the filter from the clip and discard.

4. Install the new filter into the clip. The arrow must point towards the hose that runs to the carburetor. Push the hoses onto the filter pipes, and slide the clamps back into position. Start the engine and check for leaks.



The arrow on the 20R fuel filter must point toward the carburetor line

LUBRICATION

Fuel Recommendations

Octane rating is based on the quantity of anti-knock compounds added to the fuel and determines the speed at which the fuel will burn; the lower the octane rating, the faster it burns. The higher the numerical octane rating, the slower the fuel burns and the greater the percentage of compounds in the fuel to prevent knock and preignition. As the temperature of the engine increases, the air-fuel mixture shows a tendency to ignite before the spark plug is fired and the exhaust valve is opened. This is especially important in high compression engines (compression

Preventive Maintenance Schedule*

	1970-78	1979-81
ENGINE		
Valve Clearance	6	15
Drive Belts	12	30
Engine Oil	6 ①	10 ②
Oil Filter	6 ①	10 ②
Coolant	24	30
Inspect Cooling System Hoses	12	60
Inspect Exhaust Pipes and Mountings	12	15
Engine Idle	6	15
Choke Mechanism and Linkage	12	15
Replace Fuel Filter	24	60
Replace Air Filter Element	24	30
Check Timing and Dwell	12	30 ③
Replace Points	12	—
Replace Spark Plugs	12	15
Inspect PCV Valve	6	30
Replace PCV Valve	12	30
CHASSIS		
Inspect Brake Lining and Drums	12	15
Inspect Brake Lines and Hoses	6	7.5
Steering Gear Oil Level	12	15
Ball Joint and Dust Cover	6	7.5
Check Transmission Oil Level	6	7.5
Replace Transmission Oil	24	30
Check Automatic Transmission Fluid Level	6	7.5
Replace Automatic Transmission Fluid	24	30
Wheel Bearing and Ball Joint Greasing	24	30
Grease Driveshaft	6	15
Grease Control Arm Shaft Bushings	6	7.5
Check Brake Fluid	Weekly	Weekly
Check Clutch Master Cylinder	Weekly	Weekly

*The numerals refer to months or mileage whichever comes first.

① The oil should be changed more frequently under severe service conditions.

② 2 Wheel Drive 10,000 miles or 18 months; 4 Wheel Drive 10,000 miles or 8 months.

③ Ignition timing only.

ratio of 9.0:1 or greater), where the use of low octane gas will cause combustion to occur before the piston has completed its compression stroke, thereby forcing the piston down while it is still traveling up. Fuel of the proper octane rating for the compression ratio of your engine will allow the combustion process to occur at precisely the right time thereby producing efficient, and complete burning.

The Toyota 1900 8R-C engine in the 1970-71 Hi-Lux trucks has a compression ra-

Capacities

Model	Year	Crankcase (Qt.)		Transmission (Qt.)		Trans. Case	Front Rear	Rear	Fuel Tank	Cooling System
		w/filter	w/o filter	Manual	Automatic					
Hi Lux 1900 (8R-C) and 2000 (18R-C)	70-73	5.3	4.3	1.8	7.4	—	—	1.1	12.1	7.8
2000 (18R-C)	74	5.3	4.3	2.0	6.8	—	—	1.6	13.7	9.0
2200 (20R)	75-78	4.8	3.9	2.0 ①	7.0 ④	—	—	1.6	12.1 ②	8.5 ③
2200 (20R)	79	4.9	4.0	2.0	6.7	1.7	2.0	2.1	—	7.4
2200 (20R)	80	4.9	4.0	2.0	6.7	1.7	2.4	2.3	—	8.9
2400 (22R)	81	4.9	4.0	2.1 ⑥	6.7	1.7	2.4	1.8 ⑦	13.7 ⑤	8.9
Diesel	1981	6.1	5.1	1.9	—	—	—	1.8	16.0	11.1

① 5 Speed: 2.8

② Long Bed 1976-78: 16.1

③ 7.4 1978 only

④ 6.7 1978 only

⑤ 16.1 Long Bed

⑥ 2.7 5 speed

⑦ 1.9 qt ¾ ton-2.3 qt. 4x4

tio of 9.0:1 and therefore requires premium grade fuel. The 2000 cc 18R-C engine has a compression ratio of 8.5:1 and runs at peak efficiency on regular grade gasoline. The 2200 cc 20R engine, with a compression ratio of 8.4:1, uses regular gas. However, some 1976 models, and all 1977-81 trucks must use unleaded gas, whether catalyst-equipped or not. If knocking occurs in these engines, try changing brands of gasoline. Some brands have slightly higher octane ratings than others. All 1981 and later diesels require the use of No. 2 diesel fuel.

NOTE: Your engine's fuel requirement can change with time, mainly due to carbon buildup, which changes the compression ratio. If your engine pings, knocks, or runs on, switch to a higher grade of fuel, if possible, and check the ignition timing. If it is necessary to retard timing from specifications, don't change it more than about four degrees. Retarded timing will reduce power output and fuel mileage, and will increase engine temperature. Toyota distributors have an octane selector which allows you to change the timing for this purpose. See Chapter Two for details.

Oil Recommendations

Oil which has been rated SE, heavy-duty detergent by the American Petroleum Institute is best to use under all conditions. The viscosity of the oil should be chosen from the

TEMP.		°C		-23	-12	0	10	32
		°F		-10	10	32	50	90
ENGINE OIL (SAE)	Single grade	5W	10W	20W	20	30	40	
	Multi-grade	5W 20		10W 30		20W 40		
DIFF. GEAR OIL (SAE)		80		90				

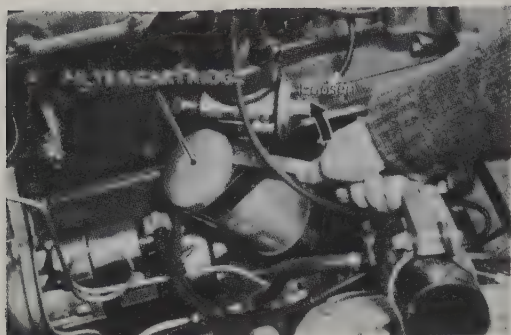
Recommended lubricant viscosities for the engine and rear axle

chart according to temperature conditions and the type of driving done.

Oil of the SE type performs a variety of functions inside the engine in addition to its basic function as a lubricant. Through a balanced system of metallic detergents and polymeric dispersants, the oil prevents the formation of high temperature and low temperature deposits and also keeps sludge and dirt particles in suspension. Acids, particularly sulfuric acid as well as other by-products of combustion, are neutralized. These acids, if permitted to concentrate, cause corrosion and rapid wear of internal parts.

Engine Oil and Filter Changing

If you purchased your Toyota Pick-up new, the engine oil should be changed at the end of the first 1000 miles. The oil should then be changed again at the 6,000 mile mark (1970-1978) and each 6,000 miles thereafter. The 1979 and later at 10,000 miles. You should also make it a practice to change the filter at every oil change. These intervals ought to be halved when the truck is oper-



Removing oil filter cartridge

ated under severe conditions, such as dusty conditions, trailer towing, prolonged high speeds, off-road driving, or repeated short trips in freezing temperatures.

To change the oil:

1. Operate the truck until the engine is at normal operating temperature. A run to the parts store for oil and a filter will accomplish this. If the engine is not hot when the oil is changed, most of the acids and contaminants will remain inside the engine.

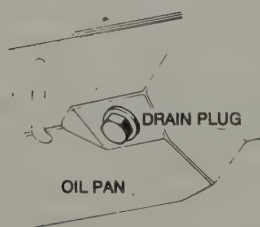
2. Shut off the engine, and slide a pan of at least six quarts capacity under the oil pan. Throw-away aluminum roasting pans can be used for this.

3. Remove the drain plug from the engine oil pan, after wiping the plug area clean. The drain plug is the bolt inserted at a slight angle into the lowest point of the oil pan.

4. The oil from the engine will be HOT. It will probably not be possible to hold onto the drain plug. You may have to let it fall into the pan and fish it out later. Allow all the oil to drain completely. This will take a few minutes.

5. The drain plug is magnetic. Wipe it off thoroughly, removing any traces of metal particles. Pay particular attention to the threads. Replace it, and tighten it snugly. Every fourth oil change, replace the drain plug gasket.

6. The oil filter is on the right side of the engine. Use a filter wrench to loosen it.



Typical oil pan drain plug location



Apply a thin film of oil to the filter gasket to prevent it from buckling

These are available at auto parts stores, among other sources. Place the drain pan on the ground under the filter. Unscrew and discard the old filter. It will be HOT, so be careful.

7. If the oil filter is on so tightly that it collapses under pressure from the wrench, drive a long punch or a screwdriver through it, across the diameter and as close to the base as possible, and use this as a lever to unscrew it. Make sure you are turning it counterclockwise.

8. Clean off the oil filter mounting surface with a rag. Apply a thin film of clean engine oil to the filter gasket.

9. Screw the filter on by hand until the gasket makes contact. Then tighten it by hand an additional $\frac{1}{2}$ to $\frac{3}{4}$ of a turn. Do not overtighten.

10. Remove the filler cap on the rocker (valve) cover, after wiping the area clean.

11. Add the correct number of quarts of oil specified in the Capacities Chart (approximately 5 quarts). If you don't have an oil can spout, you will need a funnel. Be certain you do not overfill the engine, which can cause serious damage. Replace the cap.

12. Check the oil level on the dipstick. It is normal for the level to be a bit above the full mark. Start the engine and allow it to idle for a few minutes.

CAUTION: Do not run the engine above idle speed until it has built up oil pressure, indicated when the oil light goes out.

Check around the filter and drain plug for any leaks.

13. Shut off the engine, allow the oil to drain for a minute, and check the oil level.

After completing this job, you will have several quarts of filthy oil to dispose of. The best thing to do with it is to funnel it into old plastic milk containers or bleach bottles. Then, you can either pour it into the recycling barrel at the gas station (if you're on good terms with the attendant), or put the containers into the trash.

Changing Transmission Fluid

Manual

Once every 24,000 miles (1970–78) and once every 30,000 miles (1979 and later) the oil in the manual transmission should be changed.

1. The transmission oil should be hot before it is drained. If the engine is at normal operating temperature, the transmission oil should be hot enough.

2. Raise the truck and support it properly on jackstands so that you can safely work underneath. You will probably not have enough room to work if the truck is not raised.

3. The drain plug is located on the bottom of the transmission. It is on the passenger side on four speeds, and on the bottom center of five speeds. Place a pan under the drain plug and remove it.

CAUTION: *The oil will be HOT. Be careful when you remove the plug so that you don't take a bath in hot gear oil.*

4. Allow the oil to drain completely. Clean off the plug and replace it, tightening it until it is just snug.

5. Remove the filler plug from the side of the transmission case. It is on the driver's side of four speeds, and on the passenger side on five speeds. There will be a gasket underneath this plug. Replace it if damaged.

6. Fill the transmission with gear oil through the filler plug hole. The proper oil to use is SAE 90 weight oil, API service GL-5. This oil usually comes in a plastic squeeze bottle, with a long nozzle. If yours isn't, or if the nozzle isn't long enough, you can use a rubber squeeze bulb of the type sold for kitchen use to squirt the oil in. This will come in handy for other uses as well, notably the differential. Refer to the Capacities Chart for the amount of oil needed to refill your transmission.

7. The oil level should come right up to the edge of the hole. You can stick your finger in to verify this. Watch out for sharp threads.

8. Replace the filler plug and gasket, lower the truck, and check for leaks. Dispose of the old oil in the same manner as old engine oil.

Automatic

Automatic transmission fluid should be changed every 24,000 miles (1970–78). In 1979 and later models it should be changed every 30,000 miles. It should also be changed every 12,000 miles if a lot of stop-start driv-

ing, extended high speed cruising, or trailer towing is done, or if the truck is normally operated in a heavily loaded condition.

1. The transmission fluid must be hot before it is changed. Drive the truck for ten or fifteen minutes, making a number of stops and starts. Park the truck on a level surface.

2. Get out the drain pan used for oil changes, and place it under the transmission. The drain plug is easy to spot. It is the only bolt on the flat bottom surface of the fluid pan. It is in the front corner of the pan on the passenger side until 1978. Remove the bolt to drain the fluid. Be careful—the fluid will be HOT.

3. Replace the drain plug and its gasket, after cleaning both thoroughly.

4. Since the fluid in the torque converter will not drain completely, it is a good idea to measure the volume of fluid that does drain out. This will give you a good indication of how much fluid must be replaced.

5. The transmission is refilled through the dipstick tube. You will probably need a funnel and a long tube. Use Type F automatic transmission fluid only.

6. It is important that the transmission is not overfilled. As you add fluid, stop the process from time to time, allow the fluid to drain for a minute, and check the level. When it reaches the top of the Cold level on the dipstick, stop filling.

7. Start the engine, let it idle, and shift slowly through all the gear ranges. Do not race the engine. Shut it off and check the fluid level again. If necessary, add fluid to bring it up to the cold level.

8. Now start the engine again, and take a short drive to bring the transmission to operating temperature. Drive at a high enough speed to engage third gear, but no faster. Stop on a level surface and check the fluid level once more. It should be at the top of the Hot range on the dipstick. Make certain that the transmission is not overfilled. Overfilling will cause slippage, fluid loss, and seal damage.

Changing Differential Oil

Once every 24,000 miles (1970–79), 30,000 miles (1979 and later), the differential oil should be changed. You may also want to change it if you have bought the truck used, or if the truck has been driven in water over the axle vent.

1. Park the truck on the level with the axle at normal operating temperature.
2. Place the pan used for oil changes underneath the drain plug on the differential housing.
3. Remove the filler plug. This will provide an additional vent to speed the draining process.
4. Remove the drain plug. See the illustration earlier in the chapter under Fluid Level Checks for the location of these plugs.
5. After all the oil has drained out, clean the drain plug and its gasket, and replace it.
6. Fill the differential through the filler hold with SAE 90 GL-5 gear lubricant. This usually comes in a plastic squeeze bottle with a nozzle. If not, use a squeeze bulb to squirt in the oil.
7. Fill the differential right up to the edge of the filler hole. To verify this, insert a finger, watching out for sharp threads.
8. Clean the filler plug, replace it, and check both plugs for leaks.

Chassis Greasing

Complete chassis greasing should include an inspection of all rubber suspension bushings, lubrication of all body hinges, as well as proper greasing of the front suspension upper and lower ball joints and control arm bushings. To provide correct operation, the chassis should be greased every 6 months or 6,000 miles on 1970–78 trucks. The 1979 and later trucks should be greased every 7,500 miles.

If you wish to perform this operation yourself you should purchase a cartridge type grease gun and several cartridges of multi-purpose lithium base grease. You will also need to purchase grease fittings from your Toyota dealer, as the front end components are fitted with screw-in plugs to prevent entry of foreign material.

Remove the plug, using a 10 mm wrench and install the grease fitting. Push the nozzle

Recommended Lubricants

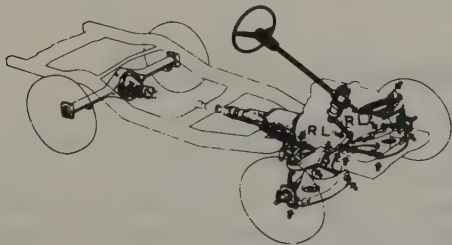
<i>Lubricants:</i>	<i>Classifications:</i>
Engine Oil	API service SE classification
Gear Oil (Transmission and Steering Gear Box)	API service GL-4 classification
Gear Oil (Differential)	API service GL-5 classification
Automatic Transmission Fluid	ATF Type F
Chassis Grease (Ball Joint Arm bushing)	NLGI No. 1 or No. 2
Driveshaft (Long Bed only)	NLGI No. 1 or No. 2
Wheel Bearing Grease	NLGI No. 2
Brake Fluid	DOT 3
Antifreeze	Anti-rust type ethylene glycol base coolant

of the grease gun down firmly onto the fitting and while applying pressure, force the new grease into the boot. Force sufficient grease into the fitting to cause the old grease to be expelled. When this has been accomplished, remove the fitting and replace the plug. Follow this procedure on each front suspension lubrication point.

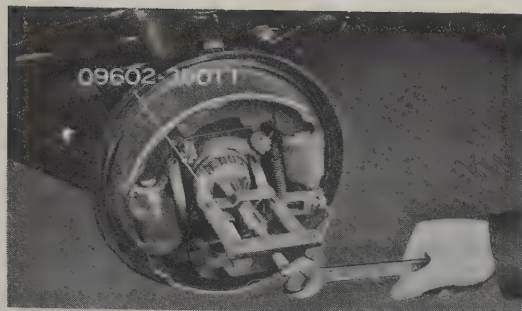
Long Bed pick-ups have a two-piece driveshaft which must be greased at the same 6 month/7,500 mile interval. The driveshaft is equipped with a grease fitting, located on the shaft just behind the center support bearing. Simply wipe off the fitting and pump in two or three shots of grease. There is no built in escape hole for the old grease to exit, so don't keep pumping in grease until the seal gives way. The factory recommends 5–10 grams of lithium base grease at the specified interval.

Wheel Bearing Adjustment and Lubrication

Only the front wheel bearings require periodic service. The lubricant to use is high



Chassis lubrication points on the Hi-Lux pick-up truck



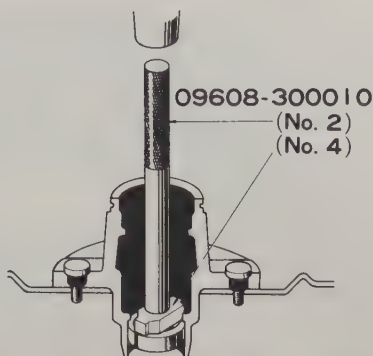
The numbers in this photograph refer to the factory tool number for the claw puller, used to remove the inner bearing on drum brakes. You can get a similar tool from a parts store or rental agency. Just make sure the fingers are thin enough to slip under the grease seal

temperature disc brake wheel bearing grease meeting NLGI No. 2 specifications. (This grease should be used even if the truck is equipped with drum brakes; it has superior protection characteristics.) This service is recommended at the specified period in the Maintenance Intervals chart or whenever the truck has been driven in water up to the hubs.

You will need a special claw-type puller for this job to remove the inner bearing and the steering knuckle grease retainer if your truck has drum brakes.

Procedures are basically the same for either disc or drum brakes.

1. Remove the brake drum or brake caliper, following the procedure outlined in Chapter 9.



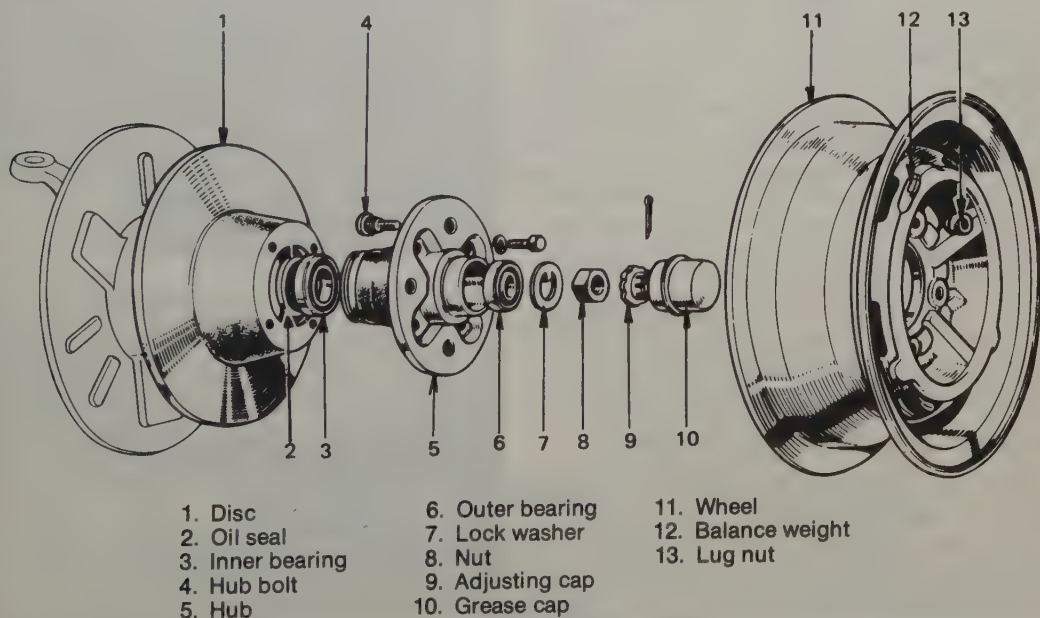
Driving out the outer bearing cup. You can do this job with a socket or pipe, or a soft brass drift, instead of the factory tool illustrated here

2. It is not necessary to remove the drum or disc from the hub. The outer wheel bearing will come off with the hub. Simply pull the hub and disc or drum assembly towards you off the spindle. Be sure to catch the bearing before it falls to the ground.

3. Drum brakes: The inner bearing and grease retainer must be pulled from the spindle with the claw puller. Be sure that the fingers of the tool pull on the seal, and not on the bearing itself. Discard the grease retainer.

Disc brakes: The inner bearing will have to be driven from the hub along with the oil seal. Use a brass rod as a drift and carefully drive the inner bearing cone out. Remove the bearing and the oil seal. Discard the seal.

4. Clean the bearings in solvent and al-



Exploded view of the front disc and hub assembly. Drum brakes are similar, but have only one castellated nut between the lock washer and grease cap

low to air dry. You risk leaving bits of lint in the races if you dry them with a rag. Clean the bearing cups in the hub.

5. Inspect the bearings carefully. If they are worn, pitted, burned, or scored, they should be replaced, along with the bearing cups in which they run.

6. You can use a brass rod as a drift, or a large socket or piece of pipe to drive the inner and outer bearing cups out of the hub.

To install:

7. Install the new inner cup, and then the outer cup, in that order, into the hub, using either the brass drift or socket method outlined earlier.

CAUTION: *Use care not to cock the bearing cups in the hub. If they are not fully seated, the bearings will be impossible to adjust properly.*

8. Drum brakes: Press a new grease retainer onto the spindle. Place a large glob of grease into one palm and force the edge of the inner bearing into it so that the grease fills the bearing. Do this until the whole bearing is packed. Press the inner bearing into the spindle, seating it firmly against the grease retainer.

Disc brakes: Coat the inner bearing cup with grease. Pack the inner bearing with grease as outlined for drum brakes, and press the inner bearing into the cup. Press a new oil seal into place on top of the bearing. You may have to give the seal a few gentle raps with a soft drift to get it to seat properly.

9. Install the hub and drum or disc assembly onto the spindle. With drum brakes, first thoroughly coat the inner cup with grease.

10. Coat the outer bearing cup with grease. Pack the outer bearing with grease and install into the cup.

11. Pack the grease cap with grease and set it aside. It will be replaced last, after the preload adjustment. You can put the grease away now.

12. Install the lock washer, and castellated nut (lock washer, nut, and adjusting castle nut with disc brakes) loosely, and go on to the preload adjustment following.

BEARING PRELOAD ADJUSTMENT

1. While turning the hub forward, tighten the castellated nut (plain nut on disc brakes) to 35 ft. lbs. (21 ft. lbs. with disc brakes).

2. Rotate the hub a few more times to snug down the bearings.

3. Retighten the nut to the above speci-

cation. Unscrew it $\frac{1}{8}$ of a turn and lock it in place with a new cotter pin. On disc brakes, snug the adjusting nut up against the nut and then back it off the required distance to insert a new cotter pin. You should not have to back it off more than $\frac{1}{8}$ of a turn.

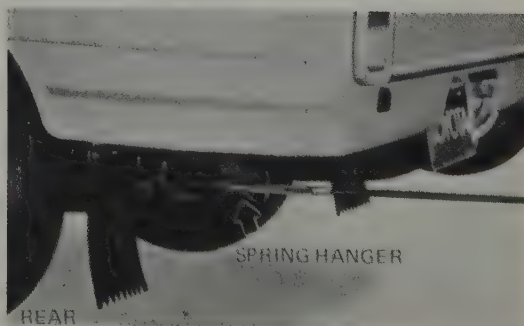
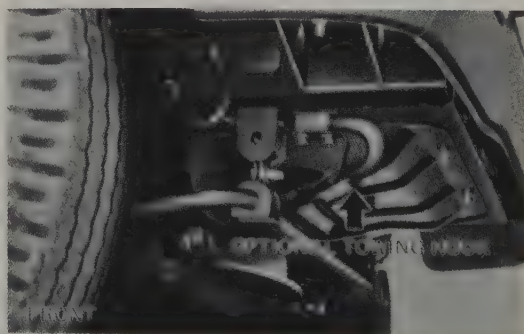
4. Install the grease cap, and wipe off any grease that oozes out.

5. Install the front wheel and a couple of lug nuts. Check the axial play of the wheel by shaking it back and forth; the bearing free-play should feel close to zero, but the wheel should spin freely. With drum brakes, be sure that the shoes are not dragging against the drum.

6. If the bearing play is correct, with drum brakes you can install the rest of the lug nuts. With disc brakes, remove the wheel, replace the caliper, then install the wheel.

PUSHING, TOWING AND JUMP STARTING

As long as your pick-up is equipped with a manual transmission, you won't have any problem towing the vehicle without the use of a wrecker. Simply attach the tow chain or cable to the towing hook at the right front of the frame, place the transmission in Neutral, and release the emergency brake. If the



Proper places to attach towing apparatus

Jump Starting a Dead Battery

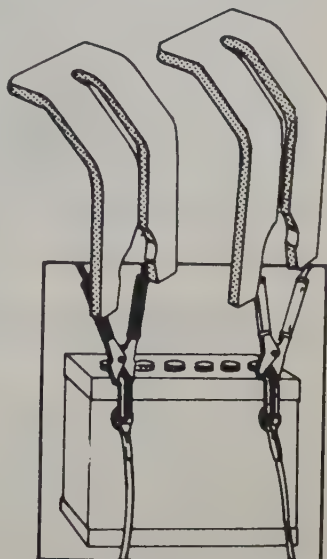
The chemical reaction in a battery produces explosive hydrogen gas. This is the safe way to jump start a dead battery, reducing the chances of an accidental spark that could cause an explosion.

Jump Starting Precautions

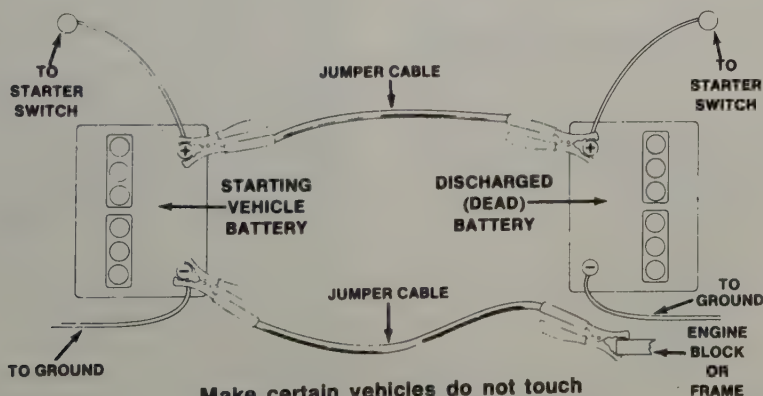
1. Be sure both batteries are of the same voltage.
2. Be sure both batteries are of the same polarity (have the same grounded terminal).
3. Be sure the vehicles are not touching.
4. Be sure the vent cap holes are not obstructed.
5. Do not smoke or allow sparks around the battery.
6. In cold weather, check for frozen electrolyte in the battery.
7. Do not allow electrolyte on your skin or clothing.
8. Be sure the electrolyte is not frozen.

Jump Starting Procedure

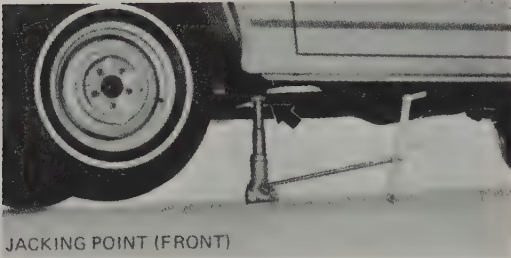
1. Determine voltages of the two batteries; they must be the same.
2. Bring the starting vehicle close (they must not touch) so that the batteries can be reached easily.
3. Turn off all accessories and both engines. Put both cars in Neutral or Park and set the handbrake.
4. Cover the cell caps with a rag—do not cover terminals.
5. If the terminals on the run-down battery are heavily corroded, clean them.
6. Identify the positive and negative posts on both batteries and connect the cables in the order shown.
7. Start the engine of the starting vehicle and run it at fast idle. Try to start the car with the dead battery. Crank it for no more than 10 seconds at a time and let it cool off for 20 seconds in between tries.
8. If it doesn't start in 3 tries, there is something else wrong.
9. Disconnect the cables in the reverse order.
10. Replace the cell covers and dispose of the rags.



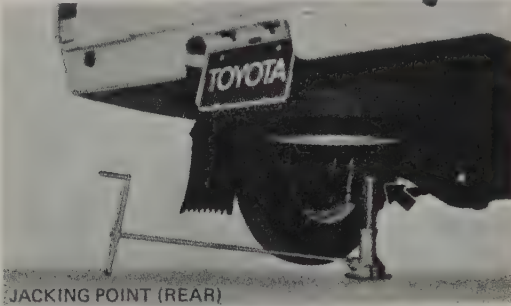
Side terminal batteries occasionally pose a problem when connecting jumper cables. There frequently isn't enough room to clamp the cables without touching sheet metal. Side terminal adaptors are available to alleviate this problem and should be removed after use.



This hook-up for negative ground cars only



JACKING POINT (FRONT)



JACKING POINT (REAR)

Front and rear jacking points

truck is equipped with a steering column locking device, the ignition switch must be in the "ACC" position.

Under emergency conditions the engine can be started by pushing. Turn the ignition switch to the ON position and place the transmission in Third gear. Depress the clutch pedal fully and when the vehicle is moving, gradually release the clutch pedal until the engine turns over. As soon as the engine catches, depress the clutch pedal again and throttle the engine gradually into life.

CAUTION: *Never under any circumstances attempt to tow or start the engine in this manner if the vehicle is equipped with an automatic transmission.*

Should you wish to tow another vehicle, attach the towing chain or cable to the rear spring hanger.

If your vehicle is equipped with an automatic transmission, the driveshaft must be disconnected from the differential if the vehicle is being towed on the rear wheels. It is not permissible to move the vehicle even the shortest distance if the driveshaft has not been disconnected.

If the rear axle of the vehicle is inoperative or if for any reason the vehicle is to be towed with the rear end elevated, the front wheels must be supported in a suitable carriage. The steering wheel locking mechanism will not keep the front wheels in position while being towed.

JACKING AND HOISTING

It is imperative that strict safety precautions be observed when raising your truck with a jack and in the subsequent supporting of the vehicle. Severe damage to the vehicle may result, not to mention the possible physical harm that may be done to yourself or some other person if you fail to exercise caution.

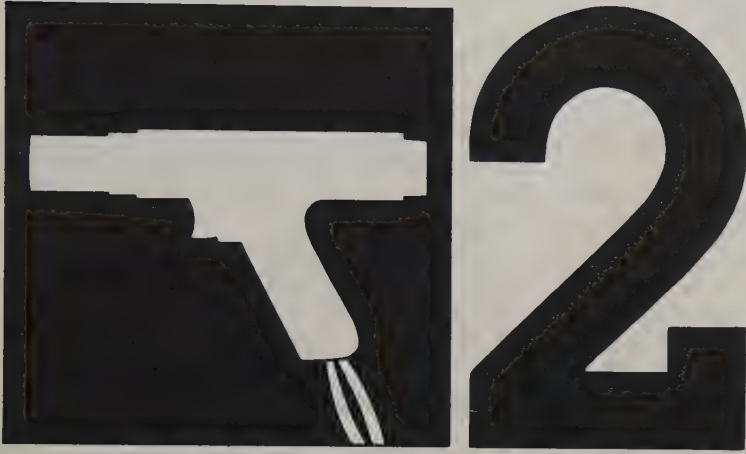
The jack should be positioned squarely on the frame of the vehicle behind the front wheel when raising the front end. The vehicle should be parked, in gear, on level ground and the emergency brake set. A block should be positioned behind the opposite rear wheel. When raising the rear of the truck, position the jack close to the inside edge of the rear leaf spring on the rear axle housing. Again, a block should be placed at the opposite front wheel.

Whenever you plan to work under the car you must support it on jackstands. Never use cinder blocks or stacks of wood to support a vehicle which you will be underneath for even a few minutes. Small hydraulic, screw, or scissors jacks are satisfactory for raising the truck. Driven-on trestles, or ramps, are also a handy and safe way to raise the truck. These can be bought or constructed from suitable heavy timbers or steel.

If the vehicle is to be raised with a hoist such as those used at service stations, the pads of the hoist should be positioned on the frame rails of the truck and never on any suspension member or underbody panel.

Whatever method you use to raise the vehicle, always be absolutely certain that it is firm in its support. When you are satisfied that it is solid, proceed with your work.

Tune-Up



TUNE-UP PROCEDURES

In order to extract the full measure of performance and economy from your engine it is essential that it be properly tuned at regular intervals. A regular tune-up will keep your engine running smoothly and will prevent the annoying minor breakdowns and poor performance that are associated with an untuned engine.

A tune-up restores the power and performance which can be lost as parts wear or fall out of adjustment through normal use. You can save time and money and achieve positive results by following an exact and methodical plan for analyzing and correcting malfunctions.

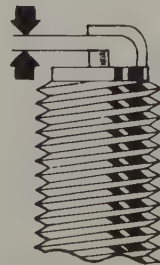
The manufacturer's recommended tune-up interval is every 12,000 miles, or twelve months, whichever comes first. This interval should be shortened if the truck is operated under severe conditions such as trailer towing, or if starting and running problems are noticed. It is assumed that the routine maintenance described in Chapter 1 has been kept up, as this will have an effect on the results of a tune-up. All the applicable steps of a tune-up should be followed, as the result is a cumulative one. If the specifications on the tune-up sticker in the engine compartment disagree with the "Tune-Up Specifications"

chart in this Chapter, the figures on the sticker must be followed. The sticker often reflects changes made during the production run. This sticker is usually found on the side of the air cleaner or at the rear of the engine compartment.

Spark Plugs

Check, clean, and adjust the spark plugs every 6,000 miles (1970-78). Inspection on 1979 and later is not necessary. Replace the spark plugs every 12,000 miles (1970-78) and at 15,000 miles (79 and later).

1. The distributor cap and the spark plug wires are usually numbered at the factory. However, if yours are not, it is a good idea to number each spark plug wire to make rein-



Adjust the spark plug gap to 0.031 in. with a wire gauge



Pull on the rubber boot, not on the plug wire

stallation easier. This can be done with pieces of adhesive tape.

2. Disconnect each spark plug wire at the plug by twisting and pulling on the rubber boot, not on the wire itself.

3. If the wires are dirty or oily, wipe them clean with a cloth dampened in kerosene and then wipe them dry. If the wires are cracked, they should be replaced. Make sure to get the radio noise suppression type. Spark plug wires normally last about 35,000 miles. If your engine is reluctant to start in wet weather, they may be the cause.

4. Blow or brush the dirt away from each spark plug. This can also be accomplished by loosening each spark plug about two turns and cranking the engine with the starter.

5. Remove each spark plug with the socket that came with the truck. Make sure that the socket is all the way down on the plug, to prevent it from slipping and cracking the porcelain insulator.

6. Refer to the "color insert" section for an analysis of spark plug condition. Generally speaking, a tan or medium grey color (rust red with some unleaded fuels) on the plug tip indicates normal combustion conditions. Spark plugs normally last about 12,000 miles. It isn't worth the time it takes to clean and gap them after that point, as they will have to be replaced shortly anyway.

7. If the plugs are to be reused (after a 6,000 mile check) 1970-78 only file the center and side electrodes flat with a small, fine points file. Heavy or baked on deposits can be scraped off with a penknife. Check the gap between the two electrodes with a spark plug gap gauge. Do not use a flat feeler gauge; an inaccurate reading will result. If the gap is not as specified (0.031 in. in most cases), use the bending tool on the gap gauge to gently bend the outside electrode to the correct setting. Always check the gap on new plugs.

CAUTION: *Never bend the center electrode.*

Be careful not to bend the side electrode too far or too often; this could cause it to break off and fall into the combustion chamber, with severe consequences, including broken piston rings and valves.

8. Clean the plug threads with a wire brush. Lubricate them with a drop of oil.

9. Screw the plugs back into the cylinder head finger tight. Then, using the socket wrench, tighten them against their seats. Do not use the same amount of force you would apply to a bolt—just snug them in. The cylinder head is made from aluminum, and the spark plug threads in it can be quite easily stripped.

10. Push the spark plug wires back onto their respective plugs, pushing on the boots. You will be able to feel them "click" into place.

Breaker Points and Condenser

1970-77

The ignition distributor breaks the primary current, distributes the high voltage surges induced in the coil secondary winding to the spark plugs according to the firing order, and sets the ignition timing in relation to engine rpm and load. The engine output, to a large extent, is governed by the ignition timing. Maximum engine output is obtained when the combustion process is well under way as the piston starts down on the power stroke. If the spark is too far advanced the engine knocks, which causes a drop in engine power output as well as overheating. If the spark is retarded part of the energy developed during combustion is wasted, resulting in poor fuel economy and reduced power output. These factors are extremely relevant in the maintenance, removal and installation of the contact points. Each time the points are reset, the ignition timing is changed.

NOTE: *If you adjust the point gap or install new breaker points, you must adjust the basic engine timing.*

There are two basically similar ignition systems used in the 1970-77 Toyota trucks. The first is a conventional ignition which uses points, condenser, coil, and distributor. The other, used from 1975-77, is a semi-transistorized unit which eliminates the condenser but includes a transistorized igniter. This igniter contains two transistors and an assortment of resistors which together serve as a switching device to turn the coil primary current on and off. The advantage of this type of

Tune-Up Specifications

Year	Engine Type	Spark Plugs		Distributor		Ignition Timing (deg)▲		Fuel Pump Pressure (psi)	Manifold Vacuum at Idle * in. Hg	Compression Pressure (psi) @ 250 rpm **	Idle Speed (rpm)		Valve Clearance † (in.)	
		Type	Gap (in.)	Point Dwell (deg)	Point Gap (in.)	MT	AT				MT	AT	In	Ex
1970	8R-C	W20 EP	0.031	52	0.018	TDC	TDC	2.8-4.3	15.7	164	650	650	0.008	0.014
1971	8R-C	W20 EP	0.031	52	0.018	10B	10B	2.8-4.3	15.7	164	650	650	0.008	0.014
1972-1973	18R-C	W20 EP	0.031	52	0.018	7B	7B	2.8-4.3	15.7 ①	164	650	650	0.008	0.014
1974	18R-C	W20 EP	0.031	52	0.018	7B	7B	2.8-4.3	15.7 ①	164	650	800	0.008	0.014
1975-1978	20R	W16 EP	0.031	52	0.018 ④	8B ③	8B ③	2.1-4.3	16.5	156	850 ②	850	0.008	0.012
1979-1980	20R	W16 EX-U	0.031	52	0.018	8B	8B	2.1-4.3	15.75	156	850	850	0.008	0.012 ⑤
1981 ⑥	22R	W16 EXR-U	0.031	Electronic	8B	8B	8B	2.1-4.3	15.8	156	700	750	0.008	0.012

▲ With automatic transmission in D (drive) and manual transmission in Neutral

* These are the minimum readings you must obtain

** Look for uniformity among cylinders rather than specific pressure

† When assembling engine cold valve clearance is Intake 0.007 and Exhaust 0.013, 1970-74 only

① 18R-C engine/manual transmission—17.7

② 800—1977-78 only

③ 13B with High Altitude Compensation—see text

④ Distributor Air Gap 0.008-0.016 in.—1978-80

⑤ 1979 20R Exhaust Valve 0.01 in.

NOTE: If these figures do not correspond to information given on the engine compartment decal, use the figures found on the decal. They are current for the engine in your truck.

⑥ 1981 Diesel specifications not currently available

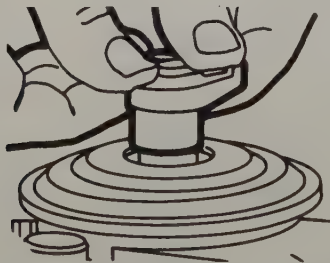
circuitry is a reduced current through the distributor breaker points, thus prolonging their expected life and reducing scheduled maintenance.

The transistorized igniter is found next to the coil on the right fender panel (as you face the truck) in 1975, and mounted on top of the coil in the same location in 1976-77. We will consider the two systems together for tune-up purposes. Igniter troubleshooting will be found following Octane Selector adjustments.

1. The distributor cap is held to the distributor body by two clips. Insert a screwdriver under their ends and release them. Lift off the distributor cap with the wires attached.

2. Wipe the inside of the cap with a clean rag. Check it for cracks and carbon tracks. A carbon track shows as a dark line running from one terminal to another. It cannot be successfully removed, so replace the cap if it has one of these. Generally, a cap and rotor will last for about 36,000 miles.

3. Pull the distributor rotor and dust cover straight up and off the distributor shaft. Inspect the rotor for wear. You can clean off the metal tip of the rotor but don't file it. Replace the rotor as necessary, or if a new one came with your tune-up kit.

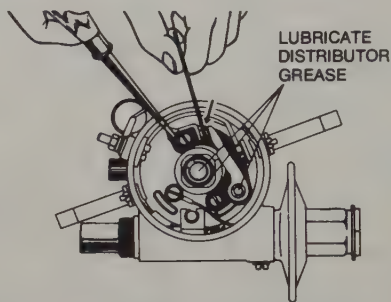


Pull straight up on the rotor to remove. When replacing, make certain that it is fully seated. The flying saucer shaped thing below the rotor is the dust cover; wipe it off thoroughly before replacing

4. The points will have to be removed whether or not they are to be reused. On some 20R engines there is dust cover over the points which must be pulled off first. Use a magnetic screwdriver when working on the points. If a screw falls into the works, the distributor will probably have to be removed to fish it out. Unfasten the wire running from the points to the distributor. There are two screws holding the points; one also locates the ground wire. Remove the screws and the points.

5. Inspect the points for wear. If they are pitted, burned, or rough, replace them. They can be reused if they are only slightly worn. File them flat with a special points file. Do not use an emery board or sandpaper, as a residue will remain that will cause arcing across the point gap.

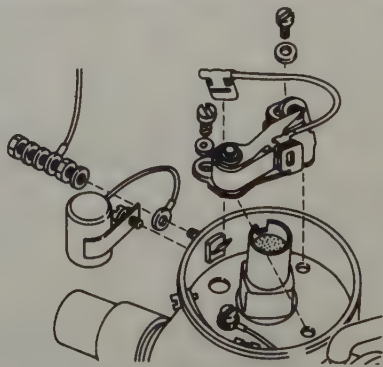
6. On 8R-Ck and 18R-C engines, remove the condenser if it is to be replaced. It is recommended that whenever the points are replaced, the condenser be replaced as well. It is attached to the outside of the distributor body with a single screw. Its wire is attached with a nut, a lockwasher, and a washer.



Adjustment of the points and lubrication of the distributor cam

7. Lubricate the distributor cam with grease. There may be a small tube of this with your tune-up kit. If not, just place a matchhead sized dab of grease on the cam and smooth it around evenly. Don't use oil—this will get on the points and cause them to burn.

8. Install the points and leave the screws slightly loose. Install the new condenser if used. Make certain that all the wires (ground, points, and condenser) are properly routed around the works.



Location of points and condenser. The screw below the points wire clip also serves to locate the ground wire, seen attached incorrectly here. For an exploded view of the entire distributor, see Chapter 3

9. Check that the points meet squarely. If not, the fixed point arm can be bent slightly with gentle force and needlenose pliers.

10. Check the operation of the centrifugal advance mechanism by turning the rotor clockwise. Release the rotor; it should return to its original position. If it doesn't, check for binding parts.

11. Check the vacuum advance unit by removing the clear plastic cap over the octane selector. Press in the octane selector and release. It should return to its original position. If not, check for binding.

12. To set the points to their proper gap, the rubbing block on the point set must rest on the high point of a cam lobe. You can rotate the engine by hand if the spark plugs are removed by moving the fan belt. Otherwise, you can bump the engine around using the ignition key or a remote starter. The important thing here is to make sure that the rubbing block is on one of the four high spots of the cam.

13. Insert a 0.018 in. flat feeler gauge between the contact points. A slight drag should be felt. If no drag can be felt, or the gauge cannot be inserted at all, adjustment is made with a screwdriver inserted into the slot cut into the end of the points base next to the fixed point. There are two raised bumps on the advance mechanism base against which to lever the screwdriver. Adjust the points to the proper gap.

14. When the points are set, tighten the points screws, and then recheck the gap. Sometimes it takes three or four tries to get

the points set correctly, so don't feel frustrated if they seem to move around on you a little. It is not always easy to feel the correct gap, either. Use gauges 0.002 in. larger and smaller than 0.018 as a test. If the points are spread slightly by a 0.020 in. gauge and not touched at all by a 0.016 in. gauge, the setting should be fine.

15. Most distributors have a damping spring located in the distributor body opposite the points. It resembles the arm and rubbing block of the points. It must be adjusted so that there is 0.002–0.018 in. clearance between its rubbing point and the flat side of the cam.

16. After all the adjustments are complete, pull a white business card between the points to clear any traces of oil or grit. It is particularly important that the points be scrupulously clean on 20R engines. The current through the points is very low and can be stopped by any slight trace of oil.

17. Replace the points cover, if so equipped, the dust shield, and the rotor. The rotor has a tab which fits in a slot cut into the distributor shaft. Reinstall the rotor. Replace the distributor cap, and snap on the clips. If you have a dwell meter, you should next set the dwell. Otherwise, go on to the ignition timing.

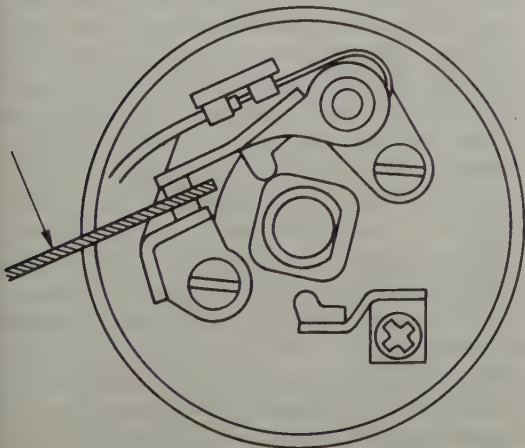
Dwell Angle

The dwell angle is the number of degrees of distributor cam rotation through which the contact points remain closed (conducting electricity). Increasing the point gap decreases dwell while decreasing the point gap increases dwell.

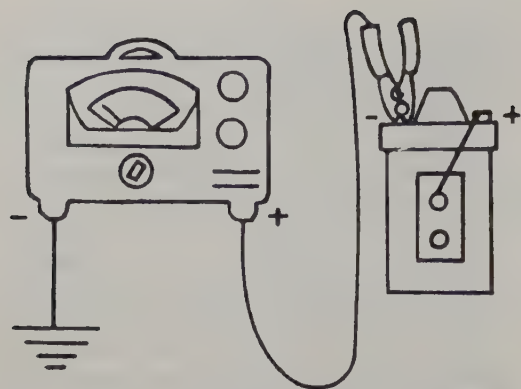
1. Connect a dwell meter to the ignition system, according to the manufacturer's instructions.

a. When checking the dwell on a conventional ignition system, connect one meter lead (usually black) to a metallic part of the truck to ground the meter; the other lead (usually red) is connected to the coil primary post (the one with the small lead which runs to the distributor body);

b. When checking the dwell on a model with transistorized ignition (20R engines), ground one meter lead (usually black) to a metallic part of the truck; hook up the other lead (usually red) to the negative (–) coil terminal. Under no circumstances should the meter be connected to the distributor or the positive (+) side of the coil.



The arrow indicates the feeler gauge used to set the point gap. Make certain that the rubbing block rests on the high spot of the cam, as shown here



Dwell meter connections with transistorized ignition

Damage to the switching transistor will result if the dwell meter is connected in the usual manner.

2. If the dwell meter has a set line, adjust the needle until it rests on the line.

3. Start the engine. It should be warmed up and running at the specified idle speed.

CAUTION: *Be sure to keep fingers, tools, clothes, hair, and wires clear of the engine fan. The transmission should be in Neutral (Park with automatics), parking brake set, front wheels blocked. Run the engine only in a well ventilated area.*

4. Check the reading on the dwell meter. If your meter doesn't have a four cylinder scale, multiply the eight cylinder reading by two.

5. If the meter reading is within the range specified in the "Tune-Up Specifications" chart, shut off the engine and disconnect the meter.

6. If the dwell is not within specifications, shut the engine off and remove the distributor cap. Adjust the point gap as previously outlined. Increasing the point gap will decrease the dwell, and vice versa.

7. Adjust the points until dwell is within specifications, then disconnect the dwell meter. Adjust the timing; see the following section.

Fully Transistorized Ignition

1978 and later

A fully transistorized ignition system, utilizing an ignition signal generating device rather than ignition points and condenser, was first used on trucks in 1978. Located in the distributor, in addition to the normal ignition rotor, is a four spoke timing rotor which rests on the distributor shaft where the

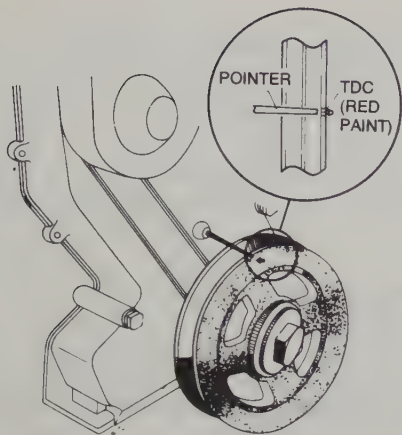
cam is found on earlier systems, a magnet, and a pick-up coil. The system also uses a transistorized igniter mounted on top of the ignition coil, found on the fender.

When a rotor spoke is not lined up with the pick-up coil, it generates large lines of flux between itself, the magnet, and the pick-up coil. This large flux variation results in a high generated voltage in the pick-up coil, preventing battery current from flowing to the pick-up coil. When a rotor spoke lines up with the coil, the flux variation is low—thus, zero voltage is generated in the pick-up coil, allowing current to flow to it. Ignition primary current is then cut off by the igniter, causing high voltage to be induced in the ignition coil secondary windings. The high voltage flows through the distributor to the spark plug.

Because no points or condenser are used, and because dwell is determined by the igniter, no adjustments are necessary. Ignition timing is checked in the usual way, but it is not likely to ever change very much. When checking timing, be sure to observe the caution about connecting the tachometer positive terminal to the negative terminal of the ignition coil.

Ignition Timing

Ignition timing must be checked at every tune-up and whenever the points are adjusted or replaced. Ignition timing is checked with a timing light. This instrument is connected to the number one spark plug of the engine, which is the one closest to the front. The timing light flashes every time an electrical current is sent from the distributor through to the No. 1 spark plug. The crankshaft pulley of the engine is notched, and the front cover of the engine (timing cover) has a pointer (or line). When the timing pointer is aligned with the "O" notch on the pulley, the piston in the No. 1 cylinder is at Top Dead Center (TDC) of its compression stroke. With the engine running, and the timing light aimed at the timing pointer, the stroboscopic flashes from the timing light will allow you to check the ignition timing setting of the engine. The timing light flashes every time the spark plug in the No. 1 cylinder of the engine fires. Since the flash from the timing light makes the crankshaft pulley seem stationary for a moment, you will be able to read the exact position of the piston by observing the marks on the crankshaft pulley.



Timing marks 8R-C and 18R-C engines

There are three basic types of timing light available. The first is a simple neon bulb with two wire connections. One wire connects to the spark plug terminal and the other plugs into the end of the spark plug wire for the No. 1 cylinder, thus connecting the light in series with the spark plug. This type of light is very dim and must be held closely to the timing marks in order to illuminate them. It has the advantage of low price. The second type operates from the truck battery. Two alligator clips connect to the battery terminals, while an adapter enables the third wire to be connected to the No. 1 spark plug and wire. This type is more expensive, but it provides a nice bright flash that you can even see in daylight. The third type replaces battery current with 110 volt house current.

1. Clean off the timing marks. The timing notches in the crankshaft pulley are normally marked at the factory with red or white paint. You may want to retouch them if they are dark, using chalk or paint. Fluorescent (dayglow) paint is excellent for this purpose. You might have to bump the engine around with the starter to find the pulley marks.

2. Warm the engine to operating temperature. Connect a tachometer and check the engine idle speed to see that it is within the range found in the "Tune-Up Specifications" chart. Adjust it, if necessary, according to the procedure found at the end of this Chapter.

CAUTION: On 20R and 22R engines, connect the positive (+) tachometer terminal to the negative (-) ignition coil terminal. Do NOT connect it to the distributor side. Improper connections will damage the transistorized igniter.

3. Shut off the engine and connect a timing light according to the manufacturer's directions.

4. Disconnect the vacuum hose from the distributor vacuum unit. Plug the hose with a pencil, golf tee, or the like, being careful not to split the hose.

NOTE: On 1977 and later 20R and 22R engines with HAC (High Altitude Compensation system) there are two vacuum hoses which connect to the distributor. Both must be disconnected and plugged. These systems require an extra step in the timing procedure, found at the end of this section. You can obtain more information about the HAC in Chapter 4.

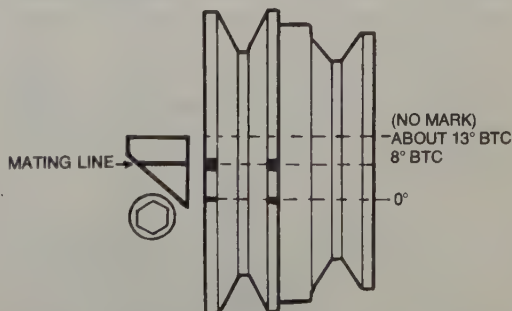
5. Be sure that the timing light wires are clear of the fan and pulleys, and start the engine.

CAUTION: Keep fingers, clothes, hair, tools, and wires clear of the fan and fan belts. They appear to be standing still when illuminated by the strobe light. Run the engine only in a well-ventilated area.

6. Allow the engine to run at the specified idle speed with the gearshift in Neutral, or Drive with automatics as the case may be. Be certain that the parking brake is set, the front wheels blocked, and don't stand in front of the truck when making adjustments with the engine running.

7. Point the timing light at the marks on the timing cover. With the engine at the specified idle, the marks should line up.

8. If the timing is incorrect, loosen the bolt at the base of the distributor just enough so that the distributor can be turned. Hold the distributor by its base and turn it slightly to advance or retard the timing as required. Once the marks are seen to align properly, tighten the bolt. If only minor corrections in



20R engine timing marks. The 8° notch is the larger and deeper of the two cut into the pulley, and must align with the mating line at idle for proper timing. The 13° indication is only for 1977-78 trucks with HAC

the timing are necessary, adjustment can be made with the octane selector, rather than by moving the distributor. See the Octane Selector section following for information.

9. After tightening the bolt, or moving the octane selector, recheck the timing. It is not unusual for it to change during the tightening process. It may take two or three tries to get it perfect. Shut off the engine, disconnect the timing light, and connect the vacuum line at the distributor, except on engines with HAC.

10. On 1977 and later engines with HAC (identified in the Note earlier) after setting the initial timing, reconnect the vacuum hoses at the distributor. Recheck the timing. It should now be about 13° BTC. There is no mark on the pulley to indicate this 13° advance in 1977. It must be estimated according to the illustration found here.

11. If the advance is still about 8° pinch the hose between the HAC valve and the three way connector. It should now be about 13°. If not, the HAC valve should be checked for proper operation.

Octane Selector

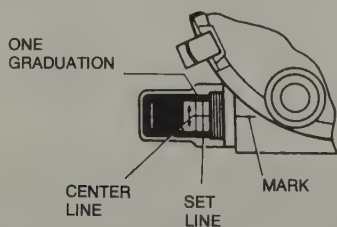
The octane selector is used as a fine adjustment to match the ignition timing to the grade of gasoline being used. It is located near the distributor vacuum advance unit, under a plastic cover. Normally the octane selector should not require adjustment, however, adjustment is as follows:

1. Align the setting line with the threaded end of the housing and then align the center line with the setting mark on the housing.

2. Drive the truck at 16–22 miles per hour in High gear on a level road.

3. Depress the accelerator pedal all the way to the floor. A slight pinging sound should be heard. As the vehicle accelerates, the sound should go away.

4. If the pinging sound is loud, or if it fails to disappear as the vehicle accelerates, retard the timing by turning the knob toward "R" (retard).



Octane selector setting

5. If there is no pinging sound at all, advance the timing by turning the knob toward "A" (advance).

6. When the adjustment is completed, replace the dust cover.

NOTE: One graduation of the octane selector is equal to about 10° of crankshaft angle.

Igniter Troubleshooting

1975–77

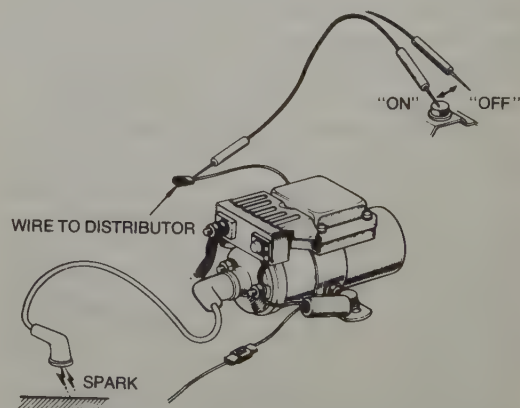
If the igniter in the 1975–77 semi-transistorized ignition is suspected as faulty, it may be checked as follows.

1. Check the coil beforehand, using the methods outlined in the "Troubleshooting" section at the end of this Chapter.

2. Check to see if there is battery voltage at the resistor terminal. Connect a test light between igniter side ballast resistor terminal and the ground bolt at the igniter, or any suitable ground. With the ignition on, the test light should indicate a complete circuit there.

3. Remove the coil primary wire from the distributor and hold it next to a ground. Disconnect the thin secondary wire from the side of the distributor. Make intermittent contacts with a suitable ground point with the secondary distributor wire. You may need an extra length of wire to do this on later models with piggyback coil and igniter assemblies. With the ignition on, sparks should be produced from the coil primary wire.

4. If no spark is produced the igniter is



Troubleshooting the igniter. Later models have a snap connector in the wire between the igniter and the distributor. On trucks with separate coil and igniter, you will not need the extra wire shown here

probably bad and should be replaced. If a spark is produced, the problem is in the points. Make certain that they are clean and properly adjusted.

Fully Transistorized Ignition Troubleshooting

1978 and later

Troubleshooting this system is easy; but you must have an accurate ohmmeter and voltmeter. The numbers in the diagram correspond to the numbers of the following troubleshooting steps. Be sure to perform each step in order.

1. Check for a spark at the spark plugs by hooking up a timing light in the usual manner. If the light flashes, it can be assumed that voltage is reaching the plugs, which should then be inspected, along with the fuel system. If no flash is generated, go on to the following ignition checks.

2. Check all wiring and plastic connectors for tight and proper connections.

3. (1) With an ohmmeter, check between the positive (+) and negative (-) primary terminals of the ignition coil. The resistance (cold) should be 1.3–1.7 ohms. Between the (+) primary terminal and the high tension terminal, the resistance (cold) should be 12–16 kilo-ohms.

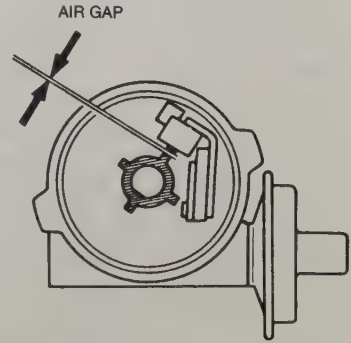
(2) The insulation resistance between the (+) primary terminal and the ignition coil case should be infinite.

4. The resistor wire (brown and yellow) resistance should be 1.2 ohms (cold). To measure, disconnect the plastic connector at the igniter and connect one wire of the ohmmeter to the yellow wire and one to the brown.

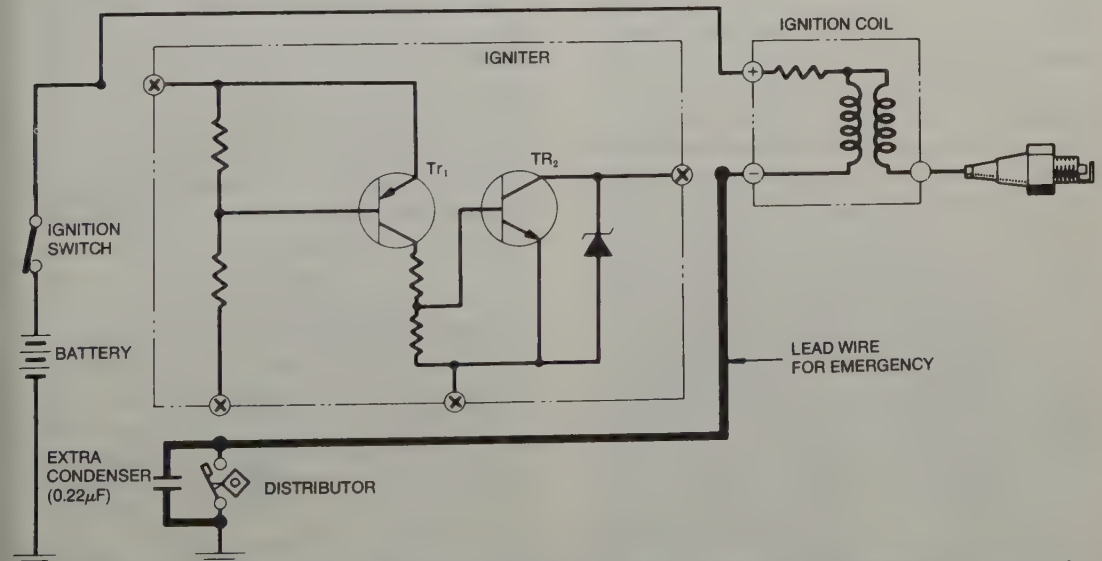
5. Remove the distributor cap and ignition rotor. (1) Check the air gap between the timing rotor spoke and the pick-up coil. When aligned, the air gap should be 0.008–0.016 in. You will probably have to bump the engine around with the starter to line up the timing rotor.

(2) Unplug the distributor connector at the distributor. Connect one wire of the ohmmeter to the white wire, and one wire to the pink wire. The resistance of the signal generator should be 130–190 ohms.

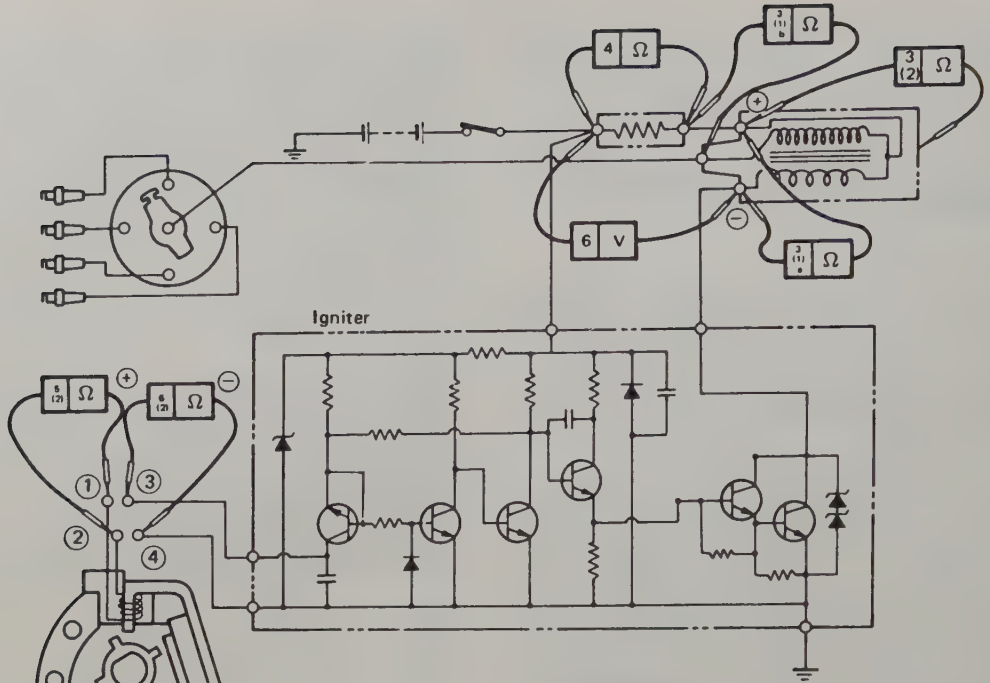
6. (1) Checking the igniter last, connect the (-) voltmeter wire to the (-) ignition coil



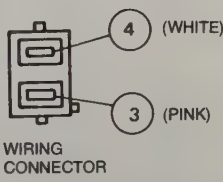
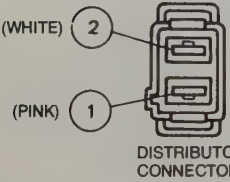
Check the air gap between the timing rotor and the pick-up coil



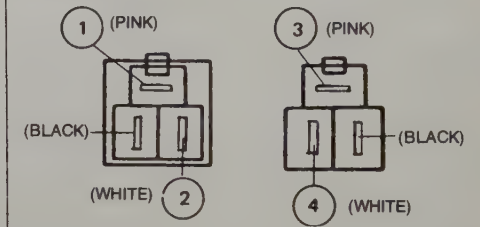
The igniter can be bypassed, if necessary, by disconnecting it entirely, and installing an automotive condenser across the points and a wire from the negative coil terminal to the positive points terminal. This only works on 1975–77 semitransistorized models



DISTRIBUTOR



FOR CANADA



Fully transistorized ignition troubleshooting

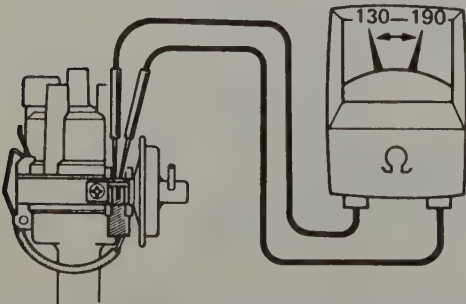
primary terminal, and the (+) voltmeter wire to the yellow resistor wire at the connector unplugged in Step 4. With the ignition switch turned to "On" (not "Start") the voltage should measure 12 volts.

(2) Check the voltage between the (-) ignition coil primary terminal and the yellow resistor wire again, but this time use the ohmmeter as resistance. Using the igniter

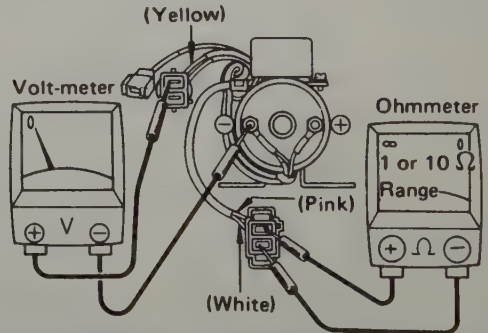
end of the distributor connector unplugged in Step 5, connect the positive (+) ohmmeter wire to the pink distributor wire, and the negative (-) ohmmeter wire to the white wire.

CAUTION: Do not intermix the (+) and (-) terminals of the ohmmeter.

Select either the 1 ohm or 10 ohm range of the ohmmeter. With the voltmeter con-



Measure the signal generator (pick-up coil) resistance at the pink and white wires



Use the ohmmeter as resistance at the igniter end of the distributor connector

nected as in Step 6 (1), and the ignition switch turned to "On" (not "Start"), the voltage should measure nearly zero.

Valve Lash Adjustment

As part of every major tune-up or once every 6,000 miles (1970–74) 12,500 miles (1975–78 20R engine), and 15,000 miles (1979 and later) the valve clearances should be checked and adjusted if necessary.

Valve adjustment determines how far the valves will open into the cylinder. If the clearance between the rocker arm and the valve is too great, part of the lift of the camshaft will be used up in removing the excess clearance; thus the valves will not open far enough into the cylinder. This will cause the valve to tap and likewise will cause the other valve train components to make an excessive amount of noise. Since the intake valves open less, the quality of air/fuel mixtures introduced into the cylinder will be less and the less the exhaust valves open, the greater the exhaust backpressure. These factors add up to a significant loss of power.

If the valve clearance is too small, the intake and exhaust valves will not fully seat on the cylinder head valve seats when they close. When the valve is tight against the valve seat it performs two functions: it seals the combustion chamber so that none of the gases in the cylinder can escape and the valve is cooled by the transference of heat to the cylinder head, which is in turn cooled by the cooling system of the engine. Therefore, if the valve clearance is too small the engine will run poorly due to the escape of gases from the combustion chambers on the compression and power strokes of the engine and the valves will overheat and burn because they cannot transfer heat properly.

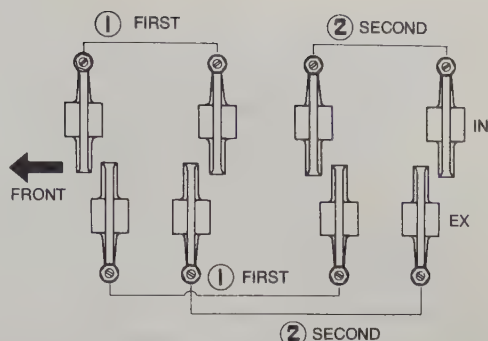
Valve adjustments must be made as accurate as possible, however, it is better to have the valve clearance somewhat larger than smaller if there is any doubt.

1. Start the engine and allow it to reach normal operating temperature (above 175°F).

2. Stop the engine. Remove the air cleaner assembly, its hoses, and bracket. Remove any other cables, hoses, wires, etc. which are attached to the valve cover. Remove the valve cover.

3. Check the torque of the valve rocker shaft bolts and the camshaft bearing bolts; they should be 12–17 ft lbs.

4. Check the torque specification of the



Valve clearance adjustment sequence—20R engine

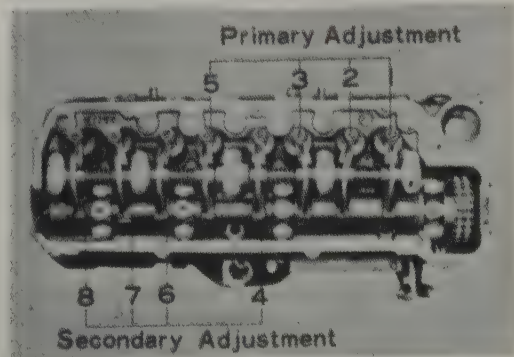
bearing cap union bolts. They should be torqued to 11–16 ft lbs.

5. Set the No. 1 cylinder to TDC on its compression stroke. To do this, remove the sparkplugs and turn the engine with a wrench applied to the crankshaft bolt. Place a finger on the No. 1 spark plug hole. When pressure is felt on your finger and the TDC line on the crankshaft pulley is aligned with the timing pointer (or line), the engine is at TDC. The rocker arms on cylinder No. 1 should be loose, and the rocker arms on cylinder No. 4 should be tight if the engine is at TDC. Note that the timing mark you are watching is not the same one used for engine timing. That notch indicates a certain number of degrees before TDC.

NOTE: Do not start the engine. Valve clearances are checked with the engine stopped to prevent hot oil from being splashed out by the timing chain.

6. Check the clearances (see the "Tune-Up Specifications" chart) and adjust the first set of valves to the proper specifications, if necessary. See the illustrations for the proper adjusting sequence.

NOTE: The clearance is measured with a



Valve clearance adjustment sequence—8R-C and 18R-C

feeler gauge between the valve stem and the adjusting screw.

7. To adjust the valve clearance, loosen the locknut and turn the adjusting screw until the specified clearance is obtained. Tighten the locknut and check the clearance again.

8. Crank the engine one revolution (360°) and perform Steps 6 and 7 for the second set of valves in the illustration. Crank the engine in a clockwise direction (to the right as you face the engine), passing the timing mark just before reaching the TDC mark.

9. Install the spark plug in the No. 1 cylinder. Install the valve cover, air cleaner assembly, and any other components which were removed.

NOTE: *If you are assembling the engine after it has been dismantled the valves must be adjusted with the engine cold. Do not start the engine before performing a valve adjustment with all the components cold. Use the clearance value for cold valves from the "Tune-Up Specifications" chart in this chapter. After adjusting the valves to their cold value, run the engine and see if the valves have the proper hot clearance. Readjust as necessary.*

CAUTION: *Damage may result to the rocker arms if the valves are not adjusted to the cold value during assembly. See Chapter 3.*

Carburetor

Carburetor adjustments should be performed as the last phase of a major engine tune-up. Adjusting the carburetor when you are uncertain of the other tune-up considerations will lead to trouble requiring professional correction. Adjusting the carburetor and the procedures involved can be simplified if you understand how the carburetor functions.

The sole function is to mix liquid fuel with air in the correct proportions to provide a combustible mixture for the engine. a partial vacuum is created by the downward movement of the pistons on their intake stroke. This vacuum draws a stream of air through the carburetor into which a jet of fuel is introduced; this air/fuel mixture is drawn into the engine by the action of that same vacuum. The amount of this mixture which enters the engine is controlled by the throttle plates in the bottom of the carburetor. When the engine is not running, these plates are com-

pletely closed. The plates are connected by various kinds of linkage to the accelerator pedal inside the vehicle. When you depress the accelerator pedal, you are opening the throttle plates and allowing more of the air/fuel mixture to be drawn into the engine, thus increasing the engine speed.

When the engine is idling, the throttle plates are kept open a specified amount by the idle speed screw which contacts the throttle lever on the outside of the carburetor.

Since it is difficult for the engine to draw a sufficient supply of mixture when the throttle plates are only slightly open at idle, an internal idle mixture passage is provided. This passage delivers air/fuel mixture to the engine through a hole located at the bottom of the carburetor below the throttle plates. This passage has an adjustment screw to regulate the flow.

Basic carburetor adjustment involves the accurate adjustment of these two devices to provide adequate, but not excessive, air/fuel mixture at idle. The method used on 8R-C and 18R-c engines is called the "maximum boost" method and requires the use of a vacuum gauge.

IDLE SPEED AND MIXTURE ADJUSTMENT

8R-C and 18R-C

NOTE: *See Chapter 4 for further information and adjustments. Perform all adjustments with the engine at operating temperature and the air cleaner assembly in place. Vehicles equipped with automatic transmission should have these adjustments performed with the transmission in Drive range. Be certain that the emergency brake is firmly set and that the front wheels are blocked.*

1. Connect a tachometer to the engine as detailed in the manufacturer's instructions.

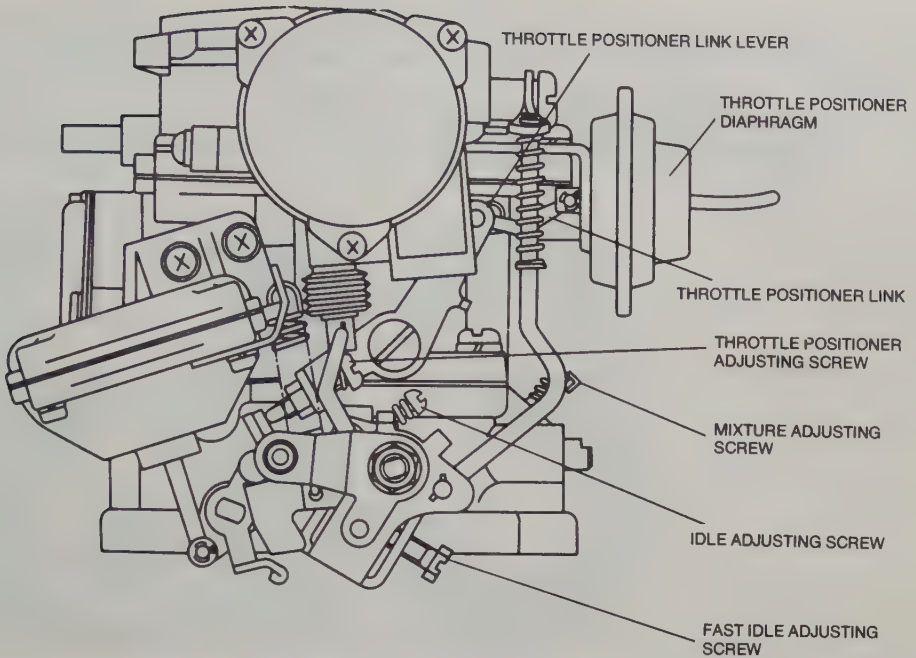
2. Remove the plug in the intake manifold vacuum port and connect a vacuum gauge by using a suitable metric adapter.

3. Start the engine and let it run at idle speed.

4. Turn the mixture screw in or out to obtain the lowest idle speed at which the engine will not stall.

5. Turn the idle speed screw to obtain the highest vacuum reading at the specified idle speed.

6. Race the engine momentarily by ma-



Location of carburetor adjustment screws—8R-C and 18R-C

nipulating the throttle linkage to verify that the engine will return to the correct idle speed.

NOTE: *If the engine will not idle smoothly at this point, perform the adjustment again.*

7. Remove the tachometer and the vacuum gauge. Install the plug in the intake manifold and road-test the vehicle.

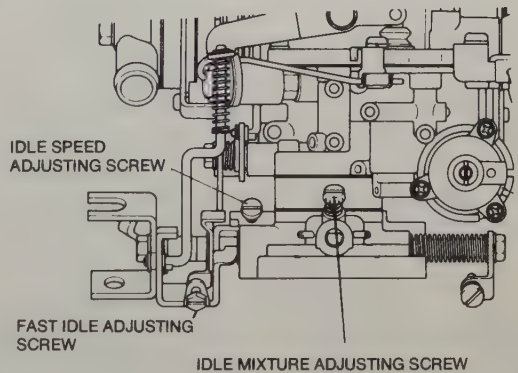
20R

The idle speed and mixture should be adjusted under the following conditions: air cleaner on, choke fully opened, transmission in Neutral (all transmissions), all accessories turned off, all vacuum lines connected, all previous adjustments (timing, dwell, etc.) made.

1. Start the engine and allow it to reach operating temperature.

2. Check the float setting on the carburetor. The fuel level should be just about even with the spot on the sight glass. If it is too high or too low, the float level will have to be adjusted following the procedure in Chapter 4.

3. Connect a tachometer to the engine. Connect the tachometer positive (+) lead to the coil negative (-) terminal. Do NOT hook it up to the distributor or positive side; damage to the transistorized ignition will result. See the illustration earlier in the Chapter



20R carburetor adjusting screws

concerning dwell meters for proper connections.

4. Adjust the engine speed to the highest rpm it will attain with the idle mixture adjusting screw.

5. Set the rpm to the idle mixture speed of 900 rpm by turning the idle speed adjusting screw. You may have to repeat Steps 4 and 5 a few times until the highest idle reached in Step 4 will go no further.

6. Now set the speed to the initial idle speed of 850 rpm by turning the idle mixture adjusting screw in (clockwise).

7. Disconnect the tachometer.

NOTE: *On later model carburetors the limiter caps are designed to limit the adjustment. These can be removed and ad-*

justed, but this should be done only by a professional mechanic with an exhaust analyzer machine to set the emissions at the proper limits. The 1981 carburetors can not be adjusted. They are preset at the factory.

22R

There is no adjustment needed on the idle mixture screw. It has been pre-set at the factory.

Engine and Engine Rebuilding



3

ENGINE ELECTRICAL

Distributor

REMOVAL

1. Mark the position of the spark plug wires on the distributor cap and remove the wires from the spark plugs.

2. Remove the coil primary wire and the vacuum line from the distributor. Remove the distributor cap with plug wires attached.

3. Using a dab of paint, mark the distributor housing and the block so the distributor may be relocated. Also mark the position of the rotor on the distributor housing.

4. Remove the distributor clamp, bolt and the clamp (bolt only on 20R). Pull the distributor from the block.

NOTE: It is easier to install the distributor if the engine timing is not disturbed while it is removed. Do not turn the engine over with the distributor removed.

INSTALLATION—TIMING NOT DISTURBED

1. Lubricate the drive gear with engine oil. Insert the distributor in the block and align the paint marks made during removal.

2. Engage the distributor drive with the oil pump driveshaft.

3. Install the distributor clamp, cap primary wire and vacuum line.

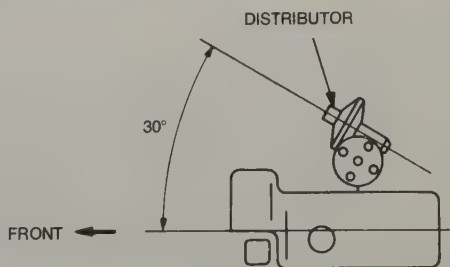
4. Install the spark plug wires. Be sure to check the positioning against the wiring diagram supplied in this chapter.

5. Start the engine. Check the timing and adjust the octane selector as outlined in Chapter 2.

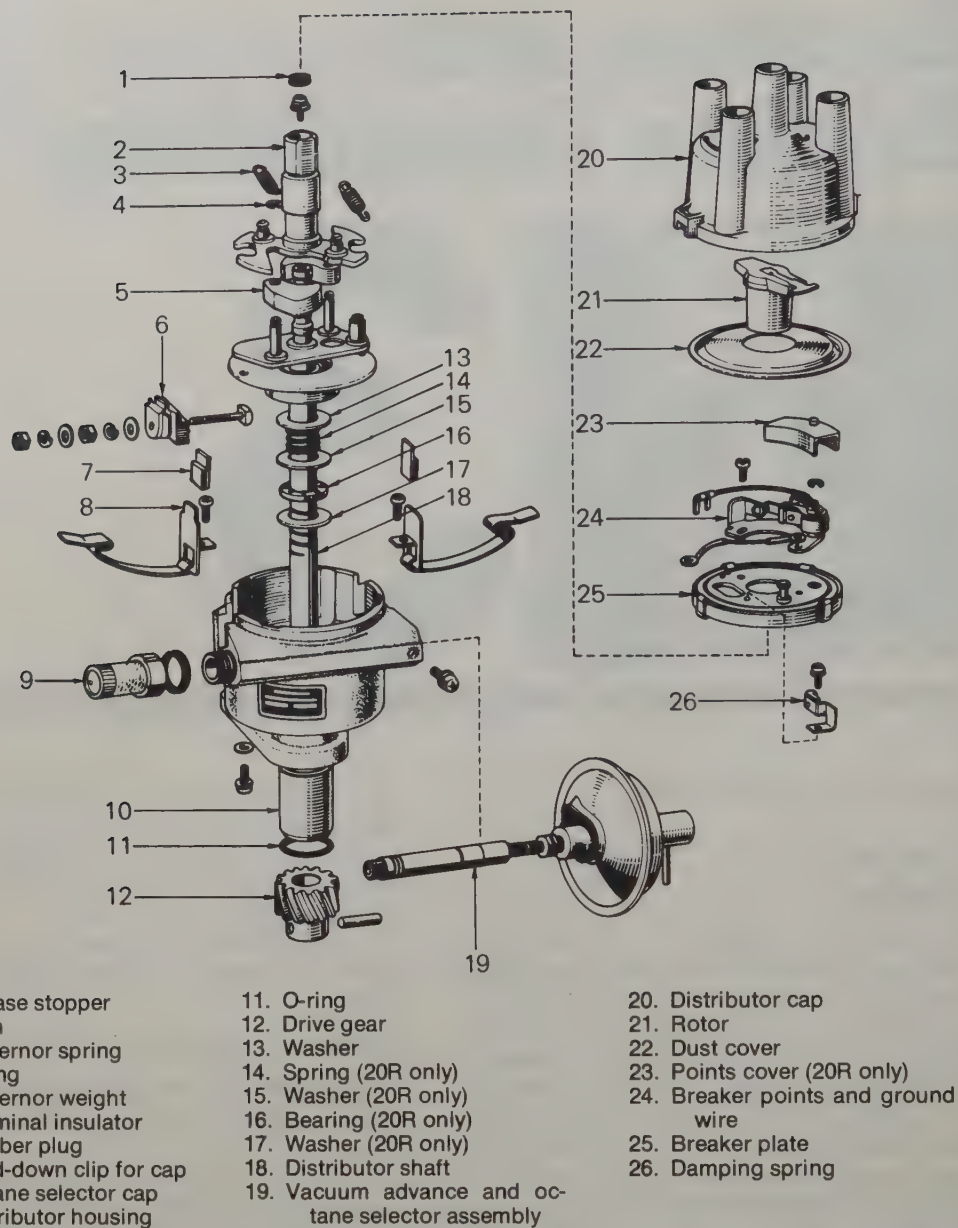
INSTALLATION—TIMING LOST

If the engine has been cranked, dismantled, or the timing otherwise lost, proceed as follows:

1. Remove the No. 1 spark plug and place a finger over the hole. Crank the engine until the compression pressure builds up. When the timing marks are exactly aligned the No. 1 piston will be at top dead center (TDC).



Installed position of the distributor—8R-C and 18R-C



20R points-type distributor. Earlier models have the condenser wire attached to the terminal insulator screw (#6 in this diagram)

2. From the "Tune-Up Specifications" chart in Chapter 2, determine the correct setting for your engine.

3. Temporarily install the rotor on the distributor shaft without the dust cover. Turn the distributor shaft until the rotor is pointing to the No. 1 firing position. The points should be just about to open.

4. Use a thin screwdriver to align the slot on the distributor drive (the oil pump driveshaft) with the key on the bottom of the distributor shaft.

5. Install the distributor in the block by rotating it slightly (no more than one gear tooth in either direction) until the driven gear meshes with the drive.

NOTE: Oil the distributor spiral gear and the oil pump driveshaft before installing the unit.

6. Rotate the distributor, once it is installed, so that the points are just about to open. This can be determined by inserting a thin piece of paper between the points. Rotate the distributor housing and the points

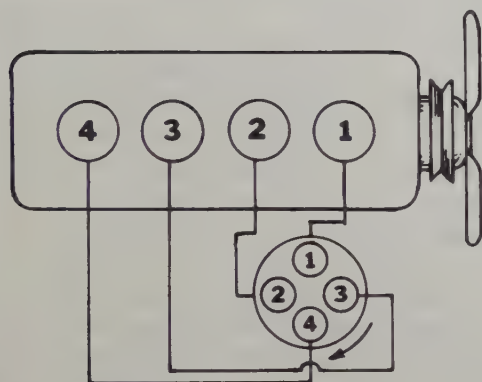
will grasp the paper. Rotate the housing the other way until you feel the points begin to release the paper, then temporarily tighten the hold down bolt.

7. Remove the rotor. Install the dust cover. Reinstall the rotor, distributor cap, primary wire, vacuum line and all spark plugs and wires.

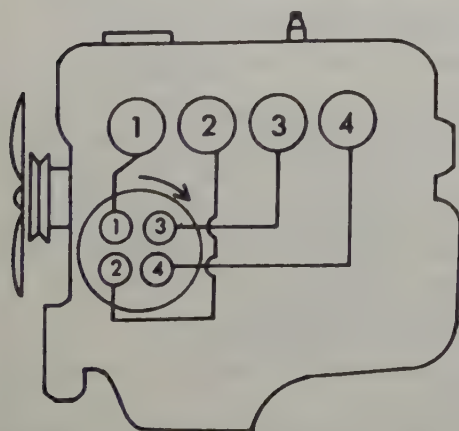
8. Start the engine and follow the instructions given in Chapter 2 for adjusting the timing, dwell angle, and the octane selector.

Firing Order

To avoid confusion replace spark plug wires one at a time.



8R-C and 18R-C



20R and 22R

Alternator

The alternator converts the mechanical energy supplied by the drive belt into electrical energy by a process of electromagnetic induction. When the ignition switch is turned on, current flows from the battery through the charging system light (or ammeter) to the voltage regulator, and finally to the alterna-

tor. When the engine is started, the drive belt turns the rotating field (rotor) in the stationary windings (stator), inducing alternating current. This alternating current is converted into usable direct current by the diode rectifier. Most of this current is used to charge the battery and to supply power for the vehicle's electrical accessories. A small part of this current is returned to the field windings of the alternator enabling it to increase its power output. When the current in the field windings reaches a predetermined level, the voltage regulator grounds the circuit preventing any further increase. The cycle is continued so that the voltage supply remains constant.

The alternator is a 40 amp Nippondenso® unit with six integral silicone diodes.

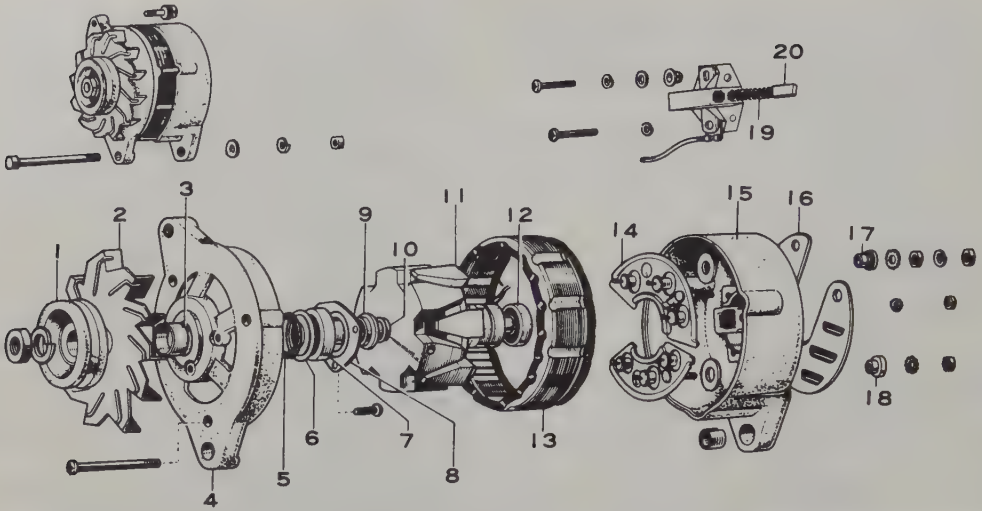
On 1979 and later models there was an optional 55 ampere alternator available. The regulator is attached directly to the back of the alternator. There is no adjustment that is necessary to this regulator. It must be replaced as a complete unit.

ALTERNATOR PRECAUTIONS

1. If the battery is removed be sure to observe the proper polarity when reinstalling. Failure to do so will result in damage to the one-way rectifiers.
2. Make sure that the battery, alternator, and regulator leads are not disconnected when the engine is running.
3. Never attempt to polarize an alternator. Never operate on an open circuit.
4. When charging a battery be sure to disconnect the output cable.
5. Always remove the ground cable when replacing any electrical component.
6. If arc welding equipment is used on the vehicle, the alternator must be disconnected.
7. Never subject the alternator to extreme temperature or dampness when steam cleaning the engine.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.
2. Loosen the alternator adjusting arm bolt and move the alternator so that the drive belt may be removed.
3. Remove the wiring connections to the alternator, and tag them for assembly.
4. Remove the adjusting bolt and the attaching bolt and remove the alternator.
5. Install in the reverse order and adjust the drive belt tension as follows: Push down on the alternator belt at a point midway be-



- | | | |
|-----------------------------|--------------------------------|----------------------------------|
| 1. Alternator pulley | 8. Bearing retainer plate | 15. Rectifier end frame assembly |
| 2. Alternator fan | 9. Space ring | 16. Rear end cover |
| 3. Space collar | 10. Snap-ring | 17. B terminal insulator |
| 4. Drive end frame assembly | 11. Alternator rotor assembly | 18. Insulator |
| 5. Felt | 12. Bearing | 19. Brush spring |
| 6. Felt cover | 13. Alternator stator assembly | 20. Alternator brush |
| 7. Bearing | 14. Holder with rectifiers | |

Alternator components

tween the fan and alternator pulleys. There should be about $\frac{3}{8}$ – $\frac{1}{2}$ in. of deflection in the belt. To adjust, simply loosen the adjusting bolt and move the alternator in the desired direction.

NOTE: *Never pry on the alternator with a metal instrument. If you must use a pry bar, use a wooden hammer handle.*

1979 and Later 55 Ampere Regulator

1. Disconnect the negative battery terminal.
2. Remove the mounting bolts and remove the alternator.
3. Disconnect the electrical wires on the alternator.
4. Remove the end cover screws and cover.
5. Remove the three screws on the terminals inside the regulator.

6. Remove the two screws from the top of the regulator and pull the regulator out.

NOTE: *This regulator can't be repaired. It must be replaced.*

7. Installation is the reverse of removal.

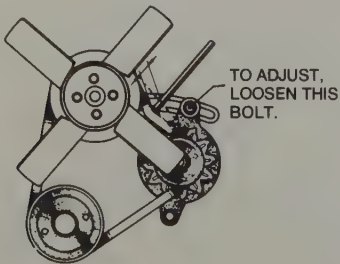
Voltage Regulator

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.
2. Disconnect the wiring harness.
3. Remove the retaining hardware and remove the regulator.
4. To install, attach the new regulator to the compartment panel, replace the wiring harness, and connect the battery cable.

VOLTAGE ADJUSTMENT

1. Connect a voltmeter to the battery terminals.
2. Start the engine and gradually increase the engine speed to about 1,500 rpm.
3. At this speed, the voltage reading should be 13.8–14.8 volts.
4. If the voltage does not fall within this range, a minor adjustment may be made to the adjusting arm. Disconnect the ground cable of the battery and remove the regulator cover. Bend the adjusting arm very slightly with a pair of needlenose pliers. Replace the cover and battery cable.



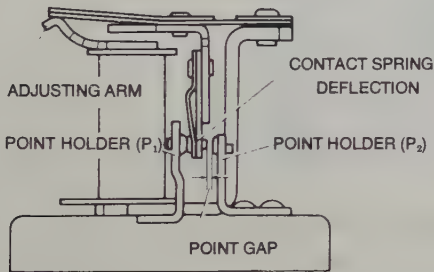
Belt tension adjustment

5. Repeat the voltage test and if the voltage cannot be brought within specification, proceed to the mechanical adjustments listed next.

MECHANICAL ADJUSTMENTS

Field Relay

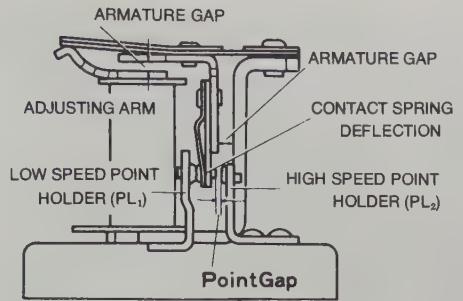
1. Remove the cover from the regulator.
2. Depress the armature and check the contact spring deflection. It should be 0.008–0.018 in.
3. Correct for deviations by bending the point holder marked P_2 in the illustration.
4. Check the point gap with a feeler gauge. It should fall somewhere between 0.016–0.047 in. If it does not, adjust by bending the point holder marked P_1 in the illustration.
5. The points can be cleaned with emery paper and solvent.



Field relay internal parts

Voltage Regulator

1. The air (armature) gap must measure 0.008 in. If it does not, adjust by bending the low speed point holder.
2. Measure the point gap with a feeler gauge. It should be 0.010–0.018 in. If it is



Voltage regulator components

not, bend the high speed point holder to correct the adjustment. Clean the points with emery paper and use a solvent to remove the dust.

3. Check the contact spring deflection with the armature depressed. It should measure between 0.008–0.018 in. as it does on the field relay. If it does not, REPLACE the regulator.

4. Perform the voltage test again. If the voltage reading cannot be brought to specification, replace the voltage regulator. If this fails to correct the situation, the alternator then must be suspected as the defective unit.

Starter

REMOVAL AND INSTALLATION

1. Disconnect the positive (+) battery cable at the battery, then at the starter.
2. Disconnect the remaining electrical connections at the starter solenoid.
3. Remove the two nuts holding the starter to the bellhousing and pull the starter toward the front of the vehicle.
4. To install the unit, insert the starter into the bellhousing being sure that the

Alternator and Regulator Specifications

					REGULATOR					
					Field Relay			Regulator		
					Contact Spring Deflection (in.)	Point Gap (in.)	Volts to Close (in.)	Air Gap (in.)	Point Gap (in.)	Volts
Year	Engine	Manufacturer	Output (amps)	Manufacturer						
1970–81	All	Nippondenso	40	Nippondenso	0.008–0.018	0.016–0.047	4.5–5.8	0.008	0.010–0.018	13.8–14.8
1979–81	All	Nippondenso	55 ①	Nippondenso	—	—	—	—	—	14.0–14.7

① 55 Ampere Alternator regulator is not adjustable

42 ENGINE AND ENGINE REBUILDING

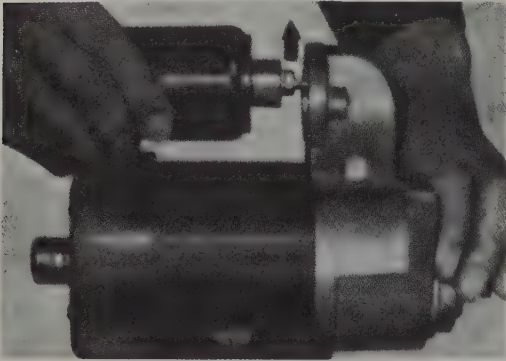
starter drive is not jammed against the fly-wheel. Tighten the attaching nuts and replace all electrical connections making the battery connection the last.

STARTER OVERHAUL

NOTE: The following instructions cover all starter components. If you are having trouble with the starter motor it is advisable to inspect the entire unit while it is out of the vehicle.

Disassembly

1. Remove the starter from the vehicle.
2. Disconnect the field coil wire from the solenoid.



Remove the starter solenoid in the direction of the arrow

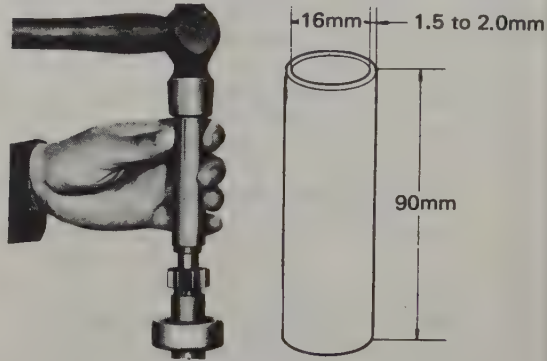
3. Remove the two solenoid retaining screws and remove the solenoid by tilting it upward to unhook the moving stud from the drive lever spring.

4. Remove the bearing cover screws and cover. Pull out the armature shaft lockplate, plate washer, seal washer and brake spring. The 20R does not have the spring.

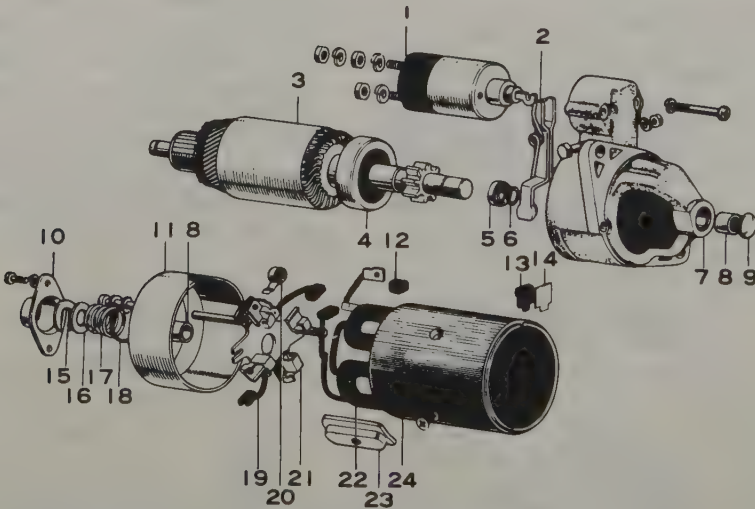
5. Remove the through-bolts and the commutator end frame.

6. Pull out the brush holder and remove the brushes.

a. At this point the brushes should be inspected. Their minimum length must be 0.47 in. If they require replacement, be sure to dress the ends of the new brushes



Removing the starter drive thrust collar



- | | | |
|-----------------------|--------------------------|------------------|
| 1. Solenoid | 9. Bearing cover | 17. Brake spring |
| 2. Engagement lever | 10. Bearing cover | 18. Gasket |
| 3. Armature | 11. Commutator end frame | 19. Brush |
| 4. Overrunning clutch | 12. Rubber bushing | 20. Brush spring |
| 5. Clutch stop | 13. Rubber grommet | 21. Brush holder |
| 6. Snap-ring | 14. Plate | 22. Field coil |
| 7. Drive housing | 15. Lockplate | 23. Pole shoes |
| 8. Bushing | 16. Washer | 24. Field yoke |

Starter motor components—8R-C and 18R-C. others similar

with emery paper. This will ensure good contact on the commutator.

7. Remove the yoke from the drive housing.

8. Remove the shift lever fulcrum bolt, the rubber piece and the plate from the drive housing.

9. Remove the armature and the drive lever from the drive housing.

10. To remove the drive unit from the armature shaft you will need a tool similar to the one pictured. (A piece of $\frac{1}{2}$ in. pipe coupling will work here).

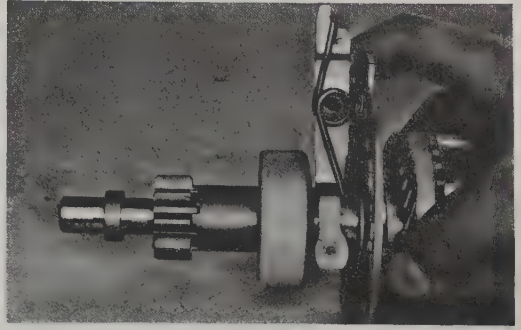
11. Place the cylinder over the shaft to bear against the pinion stop retainer. Drive the retainer down to expose the snap-ring. Remove the snap-ring from the groove in the shaft and slide the starter drive mechanism off the armature shaft. On 20R starters, there is a center bearing, a spring, and a spring holder behind the drive mechanism. These will slide off the armature shaft.

Assembly

1. Lubricate the armature shaft. Install the drive assembly with the pinion outward. Install the spring holder, spring, and center bearing onto the armature shaft first on 20R starters.

2. Slide the pinion stop retainer down over the shaft with the recessed side outward.

3. Place a new snap-ring on the drive end of the shaft and hold it in place with a block



Correctly installed starter drive lever. The 20R model is shown here; the center bearing is to the right of the drive lever. Earlier models do not have this bearing

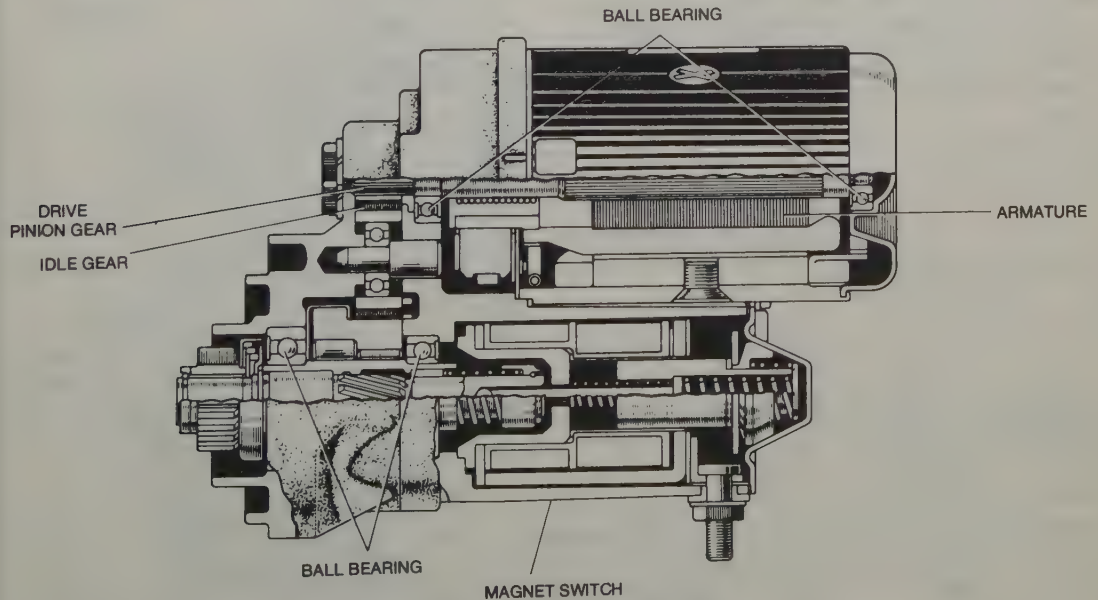
of hardwood. Strike the block with a hammer to force it over the end of the shaft. Slide the ring down into the groove on the shaft.

4. Place the thrust collar on the shaft with the shoulder next to the snap-ring and move the retainer into contact with the ring. Using pliers on opposite sides of the shaft, squeeze the retainer and the thrust collar together until the collar surrounds the ring. Pinch the collar in several places to lock the ring in place.

5. Install the drive lever onto the clutch as shown in the illustration.

NOTE: Be sure that the steel washer is located on the clutch side.

6. Lubricate the drive housing bushing and install the armature and drive unit in the housing.



Cross-section of the reduction gear starter motor

7. Install the plate and the rubber piece in the drive housing. Install the shift lever fulcrum bolt being certain that it is lubricated with multipurpose lubricant. Assemble the yoke in the drive housing.
8. Install the field frame.
9. Install the brush holder and brushes.
10. Install the commutator end frame. Be sure to coat the bushing with multipurpose grease.
11. Install the through-bolts. Inspect the thrust clearance of the armature. The clearance should be between 0.002–0.014 in. Add washers if needed.
12. Install the seal washer, brake spring, plate washer, and lock plate.
13. Pack the bearing cover with grease and install it on the end frame.
14. Hook the moving stud of the solenoid from under the spring. Install the solenoid retainers.
15. Check the clearance between the pinion and the pinion retainer. It should be 0.04–0.16 in. on earlier models, and 0.008–0.157 on 20R trucks. To adjust the clearance, the moving stud of the solenoid may be lengthened or shortened accordingly.

Testing

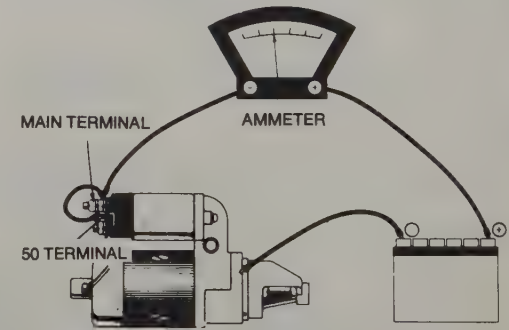
A simple no-load test should be performed before installing the starter in the vehicle. Use a fully charged battery to perform the test. Hook the test leads up as shown in the illustration. The negative side of the battery should be grounded on the starter drive housing. The positive side should run to an ammeter and then to the battery cable connection on the solenoid. The starter should rotate smoothly within the given specifications.

Battery

Refer to Chapter One for details on battery maintenance.

REMOVAL AND INSTALLATION

1. Disconnect the negative (ground) cable from the terminal, and then the positive cable. Special pullers are available to remove the cable clamps.
- NOTE: *To avoid spark, always disconnect the ground cable first, and connect it last.*
2. Remove the battery hold-down clamp.
3. Remove the battery, being careful not to spill the acid.
- NOTE: *Spilled acid can be neutralized with a baking soda/water solution. If you somehow get acid into your eyes, flush it out with lots of water and get to a doctor.*
4. Clean the battery posts thoroughly before reinstalling, or when installing a new battery.
5. Clean the cable clamps, using a wire brush, both inside and out.
6. Install the battery and the hold-down clamp or strap. Connect the positive, and then the negative cable. Do not hammer



Simplified no-load test

Battery and Starter Specifications

All cars use 12 volt, negative ground electrical systems

Year	Engine Type	Battery Amp Hour Capacity	Starter						Brush Spring Tension (oz)	Min. Brush Length (in.)
			Lock Test			No Load Test				
			Amps	Volts	Torque (ft/lbs)	Amps	Volts	RPM		
1970-74	8R-C and 18R-C	50	550	7.7	10	45	11	6,000	21	0.47
1975-80	20R	60	Not Recommended			50	11.5	5,000	21	0.47
1981	22R	60	Not Recommended			90	12.0	3,500	64	0.39

them in place. The terminals should be coated lightly (externally) with grease to prevent corrosion. There are also felt washers impregnated with an anti-corrosion substance which are slipped over the battery posts before installing the cables; these are available in auto parts stores.

CAUTION: *Make absolutely sure that the battery is connected properly before you turn on the ignition switch. Reversed polarity can burn out your alternator and regulator within a matter of seconds.*

ENGINE MECHANICAL

Design

The 8R-C and 18R-C engines are essentially the same in all respects. When the engine was first introduced in 1969 it had a displacement of 1858 cc and was enlarged to 1980 cc in 1972. The engine is an overhead camshaft design with an aluminum cylinder head and cast iron block. The camshaft drive is via a roller chain which is tensioned both by oil pressure and spring tension.

The 20R engine, introduced in 1975, is related to the 18R-C, but the only real similarity is in the basic design of the engine block. The aluminum cylinder head is of a crossflow design, with hemispherical combustion chambers and a single overhead camshaft.

The camshaft is driven by a single chain

(rather than two as on the 18R-C), and a new gear-type oil pump is used, similar to those used in automatic transmissions.

The 20R and 22R are designed with emission control devices in mind; thus, most of the passages for them, such as the EGR system, are integral castings.

Engine Removal and Installation

1. Drain the radiator, cooling system, and transmission oil. Drain the engine oil on all except the 20R engine. Some coolant remains in the head on the 20R, draining into the block when the head is removed. Thus, it is best to drain the oil after removal of the head.

2. Disconnect the negative (-) battery cable at the battery. Disconnect the positive battery cable and the solenoid relay wire at the starter.

3. Scribe the outline of the hood hinges on the hood to aid in the installation process.

4. Remove the hood.

NOTE: *It may be easier to remove the hood supports from the body.*

5. Remove the headlight bezel and the radiator grille.

6. Remove the radiator shroud, the hood lock base and the base support.

7. Detach the upper and lower radiator hoses at the engine. 20R engines have a hose running to the intake manifold to heat the choke. Remove this hose at the manifold. On trucks with automatic transmission, remove the lines from the fluid radiator and the transmission, and tag for reassembly. Remove the radiator.

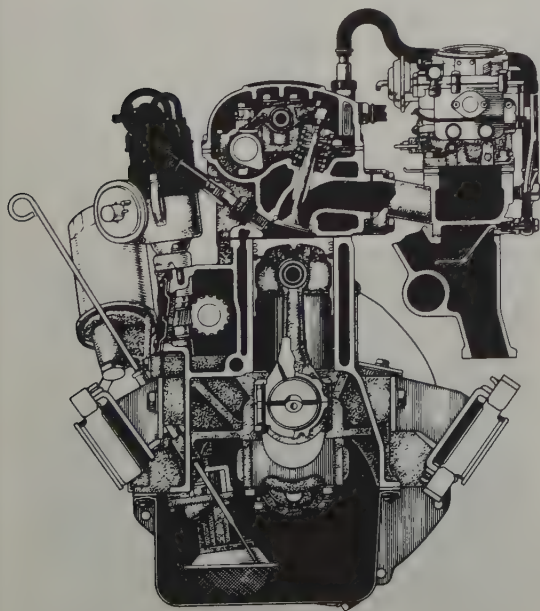
8. Unfasten the clamps and remove the heater and by-pass hoses from the engine. Remove the heater control cable from the water valve.

9. Remove the wiring from the temperature and oil pressure sending units.

10. Remove the air cleaner from the bracket along with the hoses attached to it. Cover the carburetor.

11. Remove the accelerator linkage from the carburetor. On automatic transmission models remove the transmission downshift linkage as well. Remove the brake vacuum booster hose from the intake manifold.

12. Remove the emission control system wiring and hoses as necessary. Tag for reassembly.



Front cross-sectional view of the 18R-C engine

General Engine Specifications

Year	Engine Type	Engine Displacement Cu. In. (cc)	Carburetor Type	Horsepower (@rpm)▲	Torque @rpm (ft lbs)▲	Bore x Stroke (in.)	Compression Ratio	Oil Pressure @rpm (psi)
1970-71	8R-C	113.4 (1858)	2-bbl	108@ 5500	113@ 3800	3.38x3.15	9.0:1	56.9@ 2500
1972-74	18R-C	123.0 (1980)	2-bbl	97@ 5500	106@ 3600	3.48x3.15	8.5:1	54.0@ 2500
1975-78	20R	133.6 (2189)	2-bbl	95@ 4800	122@ 2400	3.48x3.50	8.4:1	64.0@ 2500
1979-80	20R	133.6 (2189)	2-bbl	90@ 4800	122@ 2400	3.48x3.50	8.4:1	64.0@ 2500
1981	22R	156.4 (2563)	2-bbl	96@ 4800	129@ 2800	3.62x3.50	9.0:1	64.0@ 2500

▲ 1972 and later figures are SAE net ratings.

Torque Specifications

All readings in ft. lbs.

Year	Engine Type	Engine Displacement Cu In. (cc)	Cylinder Head Bolts	Rod Bearing Bolts	Main Bearing Bolts	Crankshaft Pulley Bolt	Flywheel-to-Crankshaft Bolts	MANIFOLDS	
								Intake	Exhaust
1970-71	8R-C	113.4 (1858)	75.0- 85.0	42.0- 48.0	72.0- 80.0	43.0- 51.0	42.0- 49.0	20.0-25.0 ①	
1972-74	18R-C	123.0 (1980)	72.0- 82.0	39.0- 48.0	69.0- 83.0	43.0- 51.0	51.0- 58.0	30.0-35.0 ①	
1975-79	20R	133.6 (2189)	52.1- 63.7	39.1- 47.7	68.7- 83.2	79.6- 94.0	61.5- 68.7	10.6	28.9- 36.2
1980	20R	133.6 (2189)	53- 63	40- 47	69- 83	120- 130	73- 86	13-19	29- 36
1981	22R	156.4 (2563)	53- 63	40- 47	69- 83	120- 130	73- 86	13-19	29- 36

① Intake and exhaust manifolds combined

13. Remove the clutch hydraulic line support bracket.

14. Remove the high tension line and the primary wire from the coil to the distributor at the distributor.

15. Attach the engine lifting chain and cable to the engine lift hook at the front of the engine, and draw it taut. Lift the weight of the engine off the right front engine mount so that it can be unbolted.

16. Remove the fuel line at the carburetor.

17. Remove the exhaust pipe from the exhaust manifold.

18. Remove the left front engine mount. Perform the following steps on models equipped with manual transmissions.

19. Working from inside the truck, remove the shift lever boot.

20. Unfasten the four shift lever cap re-

Crankshaft and Connecting Rod Specifications

All measurements are given in inches

Year	Engine Type	Engine Displacement Cu. In. (cc)	Crankshaft				Connecting Rod		
			Main Brg Journal Dia	Main Brg Oil Clearance	Shaft End-Play	Thrust on No.	Journal Diameter	Oil Clearance	Side Clearance
1970-71	8R-C	113.4	2.3613- 2.3622	0.0008- 0.0020	0.0020- 0.0100	3	2.0857- 2.0866	0.0008- 0.0020	0.0043- 0.0097
1972-74	18R-C	123.0	2.3613- 2.3622	0.0008- 0.0020	0.0008- 0.0080	3	2.0857- 2.0866	0.0010- 0.0021	0.0060- 0.0100
1975-80	20R	133.6	2.3614- 2.3622	0.0010- 0.0022	0.0007- 0.0079	3	2.0862- 2.0866	0.0010- 0.0022	0.0063- 0.0102
1981 ①	22R	156.4	2.3614- 2.3622	0.0006- 0.0020	0.0008- 0.0089	3	2.0862- 2.0866	0.0008- 0.0020	0.0008- 0.0087

① 1981 Diesel specifications not available

Piston and Ring Specifications

(All measurements in inches)

Year	Engine Type	Piston Clearance 68°F	Ring Gap			Ring Side Clearance (Ring to Land)		
			Top Compression	Bottom Compression	Oil Control	Top Compression	Bottom Compression	Oil Control
1970-71	8R-C	0.0010- 0.0020	0.004- 0.012	0.004- 0.012	0.004- 0.012	0.0012- 0.0028	0.0012- 0.0028	0.0008- 0.0028
1972-74	18R-C	0.0020- 0.0030	0.004- 0.012	0.004- 0.012	0.004- 0.012	0.0012- 0.0028	0.0012- 0.0028	0.0008- 0.0028
1975-80	20R	0.0012- 0.0020	0.004- 0.012	0.004- 0.012	0.004- 0.012	0.0012- 0.0028 ①	0.0012- 0.0028 ①	—
1981 ②	22R	0.0020- 0.0028	0.0094- 0.0142	0.0071- 0.0154	—	0.008	0.008	—

① Limit—0.008

② 1981 Diesel specifications not available



Removing the right front motor mount

taining screws, and remove the cap. There is a special tool available from Toyota dealers for removing the shift lever. This is illustrated in the photograph. However, you may be able to remove the shift lever with a pair of channel lock pliers. You must be able to press down and turn at the same time with whatever you use.

NOTE: On 4WD models do not forget to remove the transfer case shift lever.

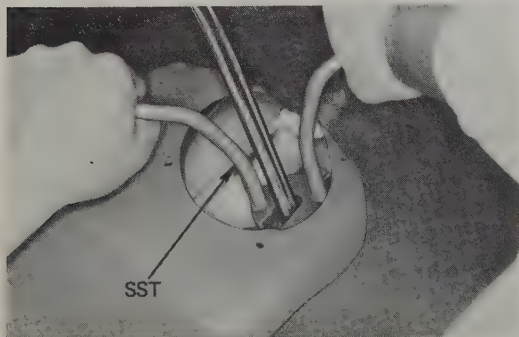
Perform the following operations on models equipped with an automatic transmission:

Valve Specifications

Year	Engine Type	Seat Angle (deg)	Face Angle (deg)	SPRING TEST PRESSURE (lbs)		SPRING INSTALLED HEIGHT (in.)		STEM-TO-GUIDE CLEARANCE (in.)▲		STEM DIAMETER (in.)	
				Inner	Outer	Inner	Outer	Intake	Exhaust	Intake	Exhaust
1970-74	8R-C and 18R-C	45	45	15.2	50.6	1.480	1.640	0.0010-0.0022	0.0014-0.0030	0.3140	0.3136
1975-77	20R	45	45	—	60 ①	—	1.594	0.0006-0.0024	0.0012-0.0026	0.3138-0.3144	0.3136-0.3142
1978-80	20R	45	44.5	—	55.1	—	1.594	0.0008-0.0024	0.0012-0.0026	0.3138-0.3136	0.3136-0.3142
1981 ②	22R	45	44.5	—	55.1	—	1.594	0.0008-0.0024	0.0012-0.0026	0.3188-0.3145	0.3136-0.3142

▲ Valve Guides Are Removable

① Limit—54 lbs. ② 1981 Diesel specifications not available



You should be able to remove the manual transmission shift lever with a pair of channel lock pliers, rather than the special service tool indicated here

21. Remove the transmission selector linkage by disconnecting the selector rod from the transmission.

22. Disconnect the neutral safety switch wiring.

Perform the following procedures on all models:

23. Raise the rear end of the vehicle and support it on jackstands.

CAUTION: *Never depend on a jack alone to support the truck when you are under it.*

24. Remove the parking brake equalizer support bracket and remove the cable which runs from the parking brake lever to the equalizer.

25. Remove the speedometer cable from the transmission. Disconnect the back-up light wiring.

26. The driveshaft is connected to the transmission with a square mating plate. There are two marks on the plates; make sure that the marks are visible before removing the four bolts which hold the plates together.

27. Remove the clutch slave cylinder complete with its lines.

NOTE: *Do not remove the lines from the cylinder, this way you won't have to bleed the unit upon reassembly.*

28. Place a jack under the transmission and with the weight off the rear support member, remove the retaining bolts and the support.

29. Using a suitable engine lifting mechanism, attach the hooks to the lifting lugs on the engine.

30. Remove the jack from under the transmission.

31. Raise the engine while moving it gradually toward the front of the truck. Once the engine/transmission unit is raised off its supports, stop and check for any lines running to it which must be disconnected. Almost inevitably there will be something left attached to the engine which must be removed, so be sure to make a thorough check. Remove the engine/transmission unit through the front of the grille opening. Be careful not to bang the transmission against the firewall.

32. Upon reinstallation, reverse the above procedures. Reinstall the radiator, transmission, and crankcase, and check all connections for leaks. Be sure to match up the marks on the driveshaft and transmission

before bolting them together. Refer to the appropriate sections for adjustments to the various linkages and systems.

Cylinder Head

REMOVAL AND INSTALLATION

8R-C and 18R-C

CAUTION: Do not perform this operation on a warm engine.

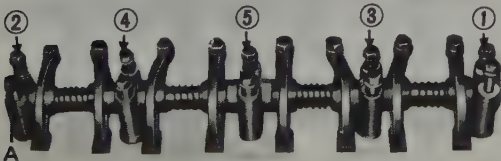
1. Disconnect the negative battery cable and drain the cooling system.
2. Remove the air cleaner assembly.
3. Detach the throttle cable from its support on the cylinder head as well as the carburetor.
4. Remove the water hose bracket from the valve cover.
5. Remove any cooling system hoses which are in the way.
6. Disconnect the PCV hose from the valve cover.
7. Remove the vacuum lines from the distributor advance unit. Remove the lines which run from the vacuum switching valve to the various emission control systems on the engine.
8. Remove the fuel and vacuum lines from the carburetor.
9. Remove the automatic choke stove pipe.
10. Remove the spark plug wires. Remove the combination intake and exhaust manifold.
11. Remove the valve cover screws and the valve cover.

NOTE: Be sure not to let anything fall into the timing case opening.

12. Remove the thermostat housing complete with thermostat and upper radiator hose.

13. Remove the rocker arm assembly and oil delivery pipes.

CAUTION: When loosening the bolts on the rocker arm assembly, loosen them in the order shown in the illustration. They



8R-C and 18R-C rocker arm shaft removal sequence. Pulling out of the rocker shaft bolts (A) will allow removal of the rocker supports, so leave the bolts in place unless this is required



Removing the camshaft

should be removed gradually and evenly in three stages. Reduce the torque on each bolt in sequence. Use a torque wrench!

14. Remove the bolts securing the timing gear to the camshaft. Support the chain so that it does not fall inside the cover.

15. Remove the camshaft bearing caps and remove the camshaft.

NOTE: Temporarily assemble the caps on their respective saddles. Keep the bearings in their proper order. These parts must be reassembled in their original order!

16. Loosen the cylinder head bolts in three stages in the sequence illustrated. Lift the cylinder head off the block.

NOTE: Do not attempt to slide the cylinder head as it is positioned with dowels. Never pry under the head with any tool as you will damage the surface.

Installation is performed in the following order:

1. Remove any water from the cylinder head bolt holes.

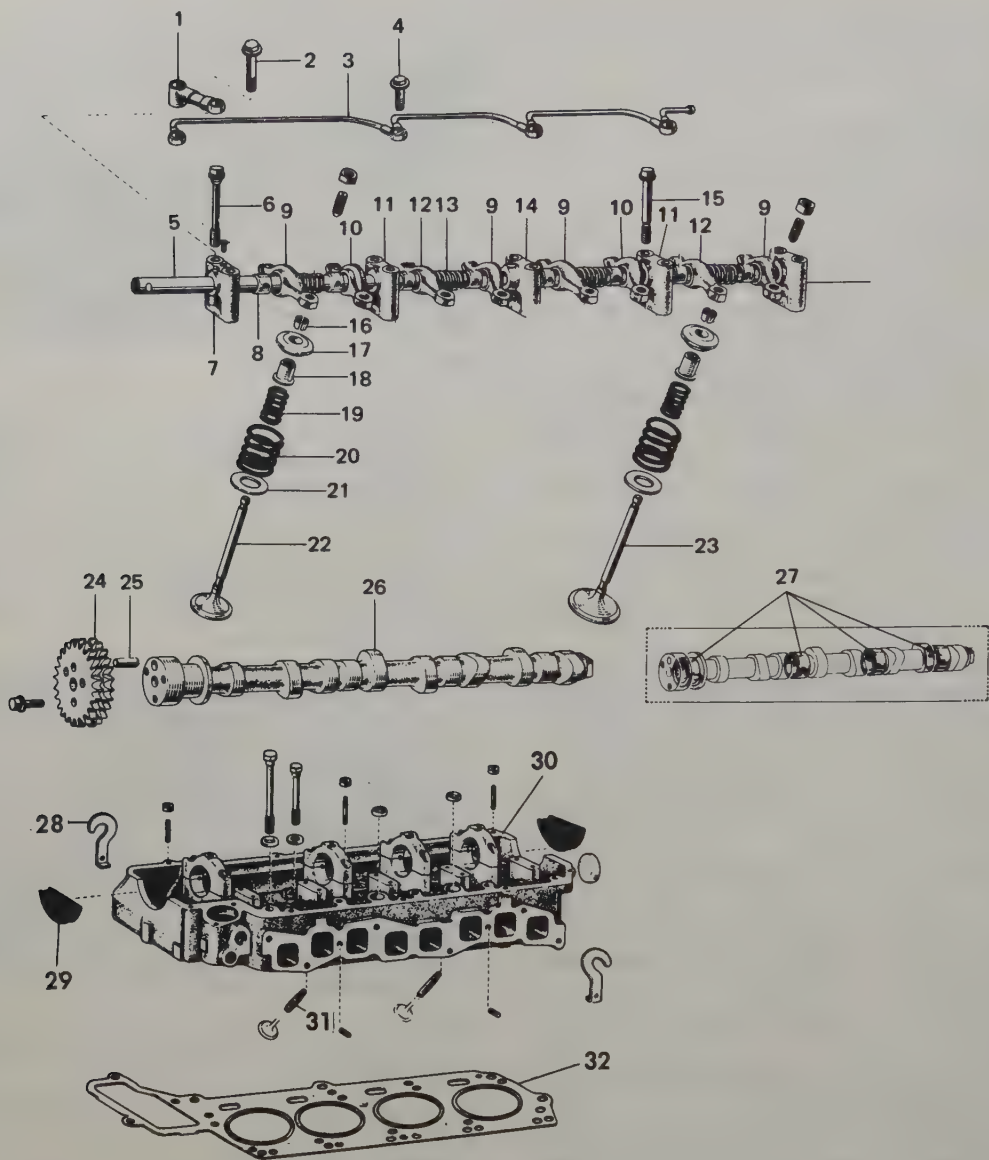
2. Clean the mating surfaces of the cylinder head and the block. Coat the area around the cylinder head bolt holes with sealer and install the cylinder head gasket on the block. Be certain that all the oil and coolant holes are open and not covered by some part of the gasket.

3. Lower, do not attempt to slide, the cylinder head onto the block.

4. Clean the threads of the cylinder head bolts thoroughly and give them a light coat of oil. Insert all of the bolts and tighten them in three or four stages to 75–85 ft. lbs.

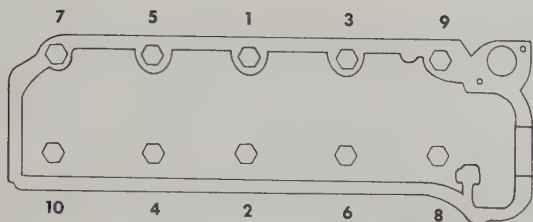
CAUTION: The head bolts must be tightened in the proper sequence and they must be tightened in several stages. Not following this procedure exactly will result in damage to the cylinder head.

5. Install each camshaft bearing lower half into the saddle from which it was re-



- | | | |
|----------------------------------|----------------------------------|--------------------------|
| 1. Oil banjo fitting | 12. Rocker arm type #3 | 24. Camshaft sprocket |
| 2. Bolt | 13. Spring | 25. Dowel pin |
| 3. Oil pipe assembly | 14. Valve rocker support type #3 | 26. Camshaft |
| 4. Bolt | 15. Bolt | 27. Camshaft bearing set |
| 5. Valve rocker shaft | 16. Valve keeper | 28. Engine lifting hook |
| 6. Bolt | 17. Spring retainer | 29. Half circle cam seal |
| 7. Valve rocker support type #1 | 18. Valve stem oil seal | 30. Cylinder head |
| 8. Bushing | 19. Inner valve spring | 31. Valve guide |
| 9. Rocker arm type #1 | 20. Outer valve spring | 32. Head gasket |
| 10. Rocker arm type #2 | 21. Spring seat | |
| 11. Valve rocker support type #2 | 22. Exhaust valve | |
| | 23. Intake valve | |

8R-C and 18R-C cylinder head components



Tightening sequence for 8R-C and 18R-C cylinder head bolts. Tighten to specified torque in three passes. Loosen the bolts in the reverse of the order shown here, in two passes

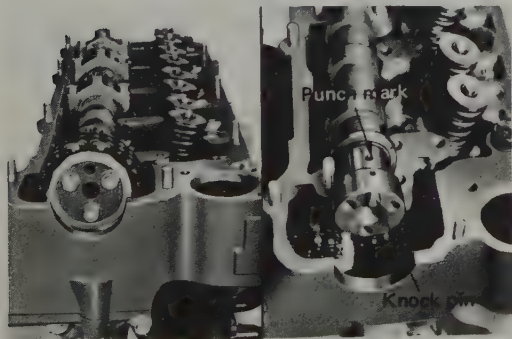
moved. Coat the bearing surface with oil. Place the camshaft into the cylinder head. Then insert each camshaft upper bearing half into the bearing cap from which it was removed and install the bearing caps on the saddles.

CAUTION: *It cannot be overemphasized that the parts must be replaced in their original positions. Damage to the camshaft bearing surfaces and the entire valve train may result otherwise.*

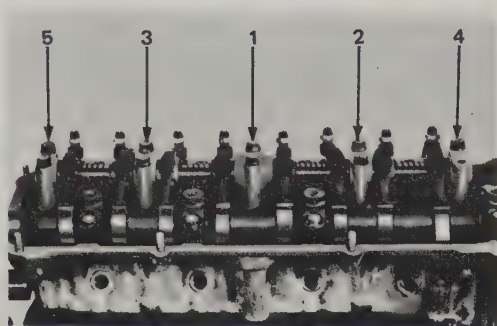
6. Tighten the camshaft bearing caps to 12–17 ft. lbs.

7. In order to reestablish the correct engine timing it is necessary to align three timing marks located on the timing chain, timing sprocket, and the camshaft. Crank the engine until the No. 1 cylinder is at top dead center of the compression stroke. The mark on the timing chain must align with the dowel hole on the camshaft timing gear and the mark on the camshaft must align with the same dowel hole on the sprocket. When the marks have been aligned in this manner, install the timing gear on the camshaft.

NOTE: *All three marks should align so that they are facing upward.*



Align the marks on the sprocket, camshaft and timing chain. Some early 8R-C engines have only one white line painted on the chain, rather than the two shown here. On those models the mark goes directly over the dowel pin



8R-C and 18R-C rocker arm shaft tightening sequence

8. Install the rocker arm assembly and tighten the attaching bolts to 12–17 ft. lbs. according to the sequence illustrated.

NOTE: *Be sure that you tighten the bolts in several stages thus avoiding damage to the assembly.*

9. Install the oil delivery pipe.

10. Install all other external components removed to gain access to the cylinder head.

11. Adjust the valves as outlined in Chapter 2, using the cold valves from the "Tune-Up Specifications" chart.

CAUTION: *Do not start the engine until the valves have been adjusted properly.*

20R Engine

CAUTION: *Do not perform this operation on a warm engine.*

1. Disconnect the battery, negative cable first.

2. Remove the three exhaust pipe flange nuts and separate the pipe from the manifold.

3. Drain the cooling system, both the radiator and the block. The engine block drain is on the driver's side of the engine. The coolant, if good, may be reused.

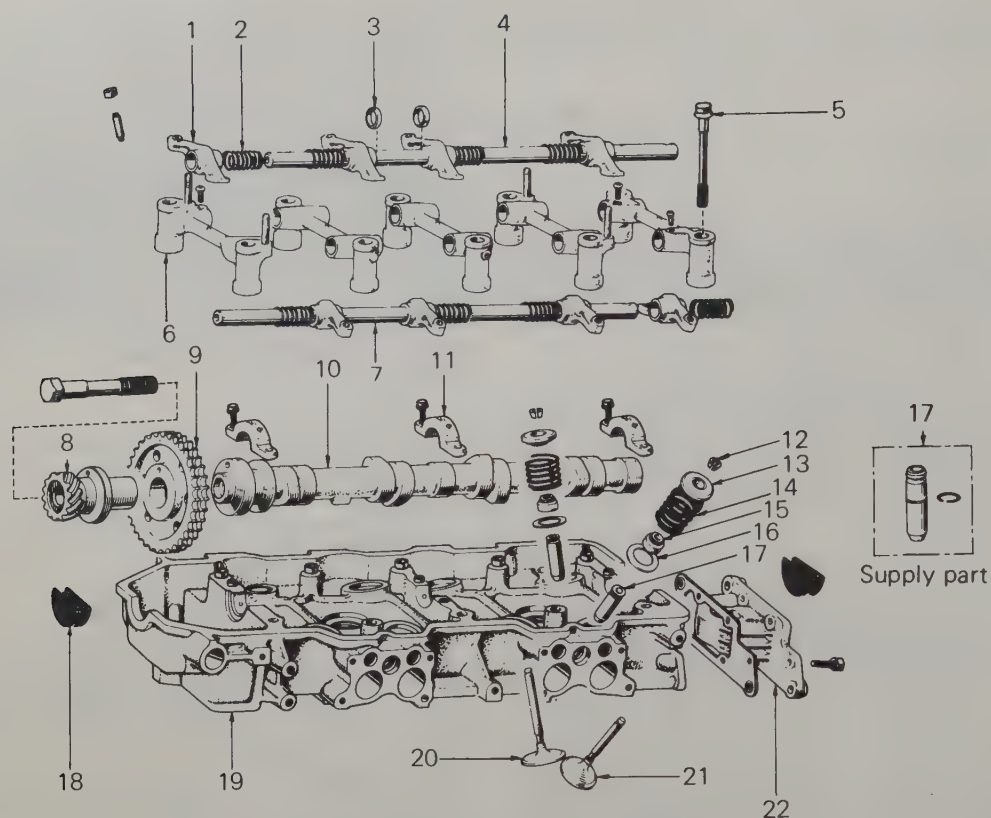
4. Remove the air cleaner assembly complete with hoses, from the carburetor.

NOTE: *Cover the carburetor with a clean cloth so that nothing can fall into it.*

5. Tag all the various vacuum and emission hoses for reassembly and disconnect them at the engine or carburetor. Remove all linkages, fuel lines, coolant lines, etc., from the carburetor, cylinder head, and manifolds. Remove the wire supports.

6. Mark the spark plug leads and disconnect them from the plugs.

7. Matchmark the distributor housing and the engine block. Disconnect the high tension wire and the primary lead and remove the distributor. Installation will be eas-



- | | |
|---------------------------|-----------------------------|
| 1. Rocker arm | 12. Valve keeper |
| 2. Spring | 13. Spring retainer |
| 3. Spacer | 14. Valve spring |
| 4. Rocker shaft (intake) | 15. Valve seal |
| 5. Head bolt | 16. Spring seat |
| 6. Rocker stand | 17. Valve guide |
| 7. Rocker shaft (exhaust) | 18. Half circle cam seal |
| 8. Distributor drive gear | 19. Cylinder head |
| 9. Cam sprocket | 20. Intake valve |
| 10. Camshaft | 21. Exhaust valve |
| 11. Camshaft bearing cap | 22. Rear cover (EGR cooler) |

20R cylinder head components

ier if you leave the cap and spark plug wires in place.

8. Remove the four nuts which secure the valve cover.

9. Remove the rubber half circle cam seals. Remove the dam sprocket bolt. Slide the distributor drive gear off the camshaft and wire the cam sprocket in place to the timing chain.

10. Remove the timing chain cover bolt at the front of the head. This must be done before the head bolts are loosened.

11. Remove the cylinder head bolts in the order shown. Note that the numerical order in the illustration is for tightening, and must be reversed for loosening. Loosen the bolts in two or three stages.

NOTE: *Improper removal of the cylinder head bolts can cause head warpage.*

12. Using pry bars applied evenly at the front and rear of the valve rocker assembly, pry the assembly off its mounting dowels.

13. Lift the head straight up off its dowels. Do NOT pry it off, or attempt to slide it off.

14. Drain the engine oil from the crankcase after the head has been removed, because the oil will become contaminated with coolant when the head is removed.

Installation is as follows:

1. Clean off the top of the cylinder block and the head, using a scraper or a razor blade. Be careful not to gouge the aluminum head. You may also want to clean off the tops of the pistons, but as this requires rotation of

the crankshaft, you must be careful to keep sufficient tension on the cam chain to prevent it from slipping a tooth. Vacuum out any bits which have fallen into the cylinders, being careful not to nick the cylinder walls.

2. Apply a liquid sealer to the front corners of the block and install a new head gasket.

3. Lower the head over the locating dowels. Do not attempt to slide it into place.

4. Rotate the camshaft so that the sprocket aligning pin is at the top. Remove the wire and hold the cam sprocket tight against the chain. Manually rotate the engine so that the cam sprocket hole is also at the top. Wire the sprocket in place again.

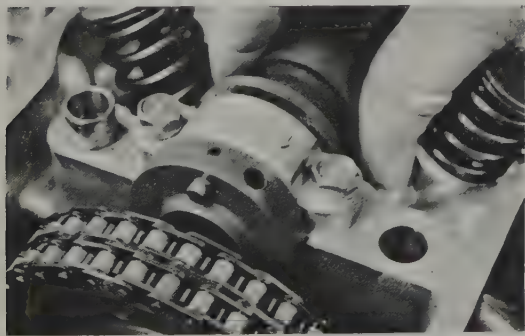
5. Install the rocker arm assembly over its positioning dowels.

6. Clean the threads of the cylinder head bolts thoroughly and give them a light coat of oil. Install them and tighten evenly, in three stages, in the sequence shown. Torque them to 52–63 ft. lbs.

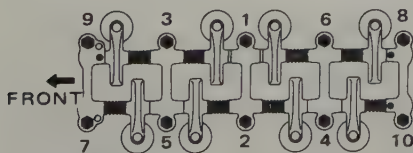
7. Install the timing chain cover bolt and tighten it to 7–12 ft lbs.

8. Remove the wire and fit the sprocket over the camshaft dowel. If the chain won't allow the sprocket to reach, rotate the crankshaft back and forth, while lifting up on the chain and sprocket.

9. Install the distributor drive gear and tighten the sprocket bolt to 51–65 ft. lbs.



Rotate the 20R camshaft so that the pin is at the top. Note that the arrow on the camshaft bearing cap points to the front of the engine



Tightening sequence for 20R cylinder head bolts. Tighten to specified torque in three passes. Loosen the bolts in the reverse of the order shown here, in two passes

10. Adjust the valves as outlined earlier. After completing the adjustment, rotate the crankshaft 352°, so that the 8° BTDC mark on the pulley aligns with the timing mark on the block.

11. Install the distributor, as outlined earlier.

12. Install the spark plugs and leads.

13. Make sure the oil drain plug is installed. Install the rubber half circle cam seals and fill the engine with oil. Pour the oil over the top of the head, onto the distributor drive gear and the valve rockers.

14. Install the rocker cover and tighten the nuts to 7–12 ft. lbs.

15. Connect all the vacuum hoses and electrical leads which were removed during disassembly. Reconnect the fuel line. Install the spark plug lead clips onto the rocker cover. Fill the cooling system. Install the air cleaner.

16. Tighten the exhaust pipe manifold nuts to 25–33 ft. lbs.

17. Reconnect the battery, negative cable last. Start the engine and allow it to reach normal operating temperature. Check the timing and adjust the idle speed and mixture. Shut off the engine and reset the valves.

Valve Service

Procedures for valve service are the same as outlined in the Engine Rebuilding section at the end of this chapter with the following exceptions and notes.

Valve guides are driven out using a stepped drift of the type illustrated in the Engine Rebuilding section. New guides are then driven in using the same drift. On 8R-C and 18R-C engines, the replacement guide is driven in until its length above the head surface is 0.63 in. On 20R engines, replacement guides have a snap-ring. The guide is driven in until the snap-ring contacts the head. These 20R replacement guides must be broken off with a drift, flush with the top of the cylinder head, before they can be removed.

In all cases, the replacement guides may have to be reamed out to provide the proper stem-to-guide clearance, found in the "Valve Specifications" chart.

Valve seats are non-replaceable, and must be resurfaced, on all engines except early 18R-C engines with serial numbers before 18R-0440901. These engines only have 6 mm (0.236 in.) deep seats. Replacement seats are .5 mm oversize, and require machine shop

54 ENGINE AND ENGINE REBUILDING

service for installation. These procedures should be discussed with your Toyota dealer, as only he has the proper parts for these engines.

Valve removal can be accomplished using the standard valve spring compressor tool. Valve removal is no problem on the 8R-C and 18R-C engines, as all the valves are arranged on one side of the head. On 20R and 22R engines, the camshaft should be removed before attempting removal of the valves. This procedure is relatively easy, however. If you have removed the head, the rocker arm assembly and the cam sprocket have already been removed. Simply remove the cam bearing cap bolts using a 12 mm socket and pull out the cam. When installing, coat all the bearings and the cam journals with engine oil, and install the bearing caps in numerical order with the arrows on the cups pointing toward the front of the engine. Torque the bolts to 12–16 ft. lbs.

Valve Rocker Shafts

Valve rocker shaft removal and installation is given as part of the cylinder head removal and installation procedure. Perform only the steps of the appropriate procedure necessary to remove or install the rocker shafts.

Note that on the 8R-C and 18R-C engines, there are three different types of rocker arms, and three different types of rocker supports; on the 20R and 22R engines all rocker arms are the same, but all rocker stands are different. If the parts are disassembled on any of the engines, they must be put back together in exactly the same order as removed. Lubricate all parts with engine oil before assembly.

Intake and Exhaust Manifold

REMOVAL AND INSTALLATION

8R-C and 18R-C

1. Remove the air cleaner along with its hoses.

1. Remove the fuel line, vacuum line, automatic choke stove, PCV hose, and accelerator linkage from the carburetor.

3. Remove the carburetor from the manifold.

4. Use a jack to raise the front end of the truck and support it firmly on jackstands.

5. Remove the exhaust pipe from the manifold.

6. Remove the manifold bolts. To do this correctly you should start with the bolts at

the center of the manifold and gradually loosen the bolts in three stages. Undue stress will be placed on the manifold if one bolt is completely removed while another remains installed at its maximum strength.

7. Always use new gaskets when installing the manifold. Tighten the bolts to 20–25 ft. lbs. and be sure to increase torque in stages working from the center.

20R and 22R Intake Manifold

1. Disconnect the battery, negative cable first.

2. Drain the cooling system.

3. Remove the air cleaner assembly, complete with hoses.

4. Disconnect the vacuum lines from the EGR valve and the carburetor. Tag them for assembly.

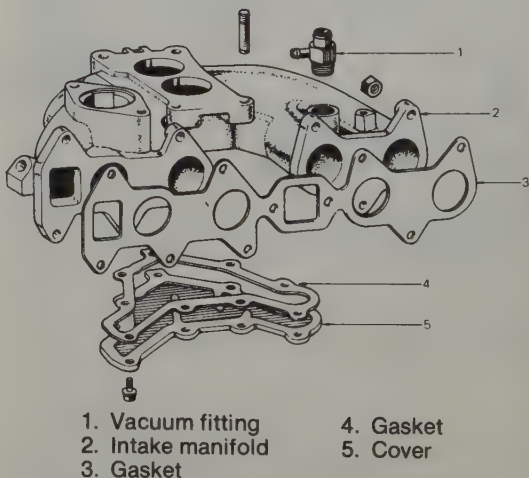
5. Remove the fuel line, accelerator linkage, electrical leads, and coolant hose from the carburetor.

6. Remove the coolant bypass hose from the manifold.

7. Unbolt and remove the intake manifold, complete with carburetor and EGR valve.

8. Cover the cylinder head intake ports with a clean cloth.

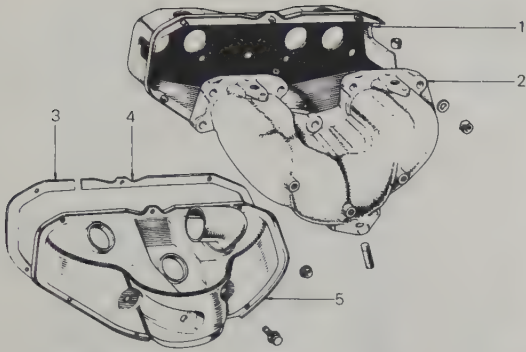
Installation is the reverse of the removal. Use a new gasket, and torque the mounting nuts to 11–15 ft. lbs. Tighten the bolts in several stages, working from the inside bolts outward. Refill the cooling system.



20R intake manifold components, 22R similar

20R and 22R Exhaust Manifold

CAUTION: Do not perform this operation on a warm or hot engine.

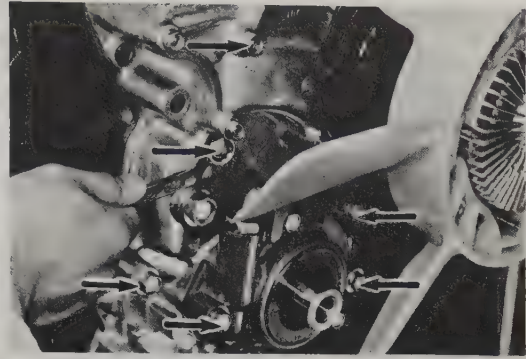


1. Inner heat stove
2. Exhaust manifold
3. Gasket
4. Gasket
5. Outer heat stove

20R exhaust manifold components

1. Remove the three exhaust pipe-to-manifold nuts and disconnect the pipe.
2. Remove the hot air intake tube from the heat stove. Remove the outer part of the heat stove.
3. Remove the manifold nuts.
4. Remove the exhaust manifold, complete with air injection tubes and the inner portion of the heat stove. It may be necessary to remove the heater hose that plugs into the driver's side of the firewall to provide space to remove the manifold. In this case the cooling system will have to be drained.

Installation is the reverse of removal. Tighten the nuts to 29–36 ft. lbs., working from the inside out, and in several stages.

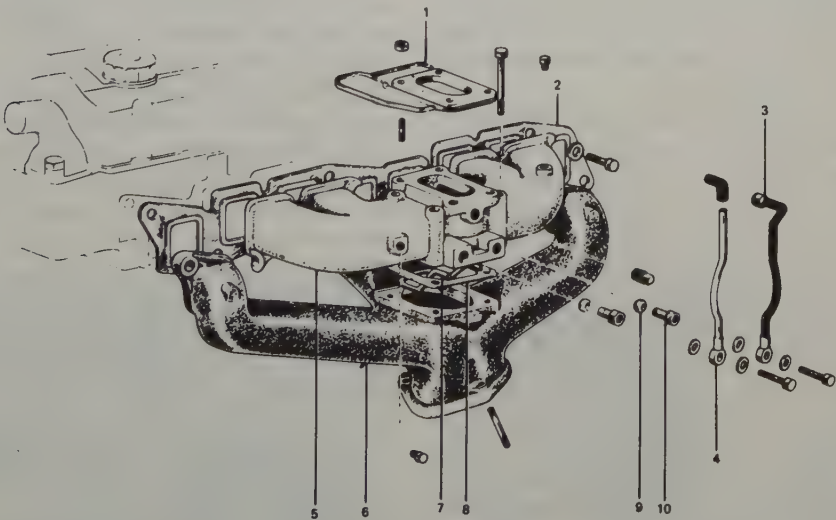


Remove the six bolts indicated on the 20R front cover

Tighten the exhaust pipe nuts to 30–36 ft. lbs.

Timing Chain Cover REMOVAL AND INSTALLATION

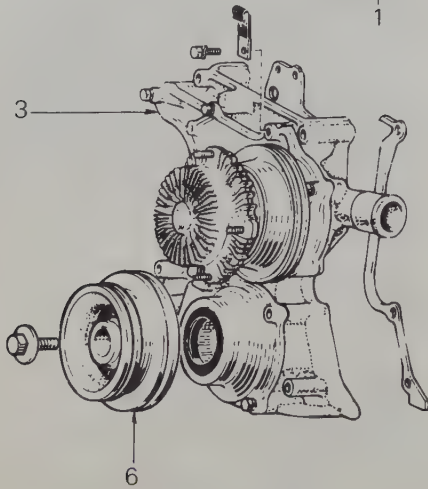
1. Remove the cylinder head.
2. After draining oil, remove the oil pan and its gasket.
3. Remove the radiator.
4. Remove the fan and drive belts.
5. Remove the air pump, hoses, and bracket, if so equipped.
6. On 8R-C and 18R-C engines, remove the alternator and its bracket. Tag the wires for assembly. On 20R engines remove the alternator adjuster bracket and move it towards the alternator.



1. Heat insulator
2. Manifold gasket (manifold-to-head)
3. Choke stove outlet pipe
4. Choke stove intake pipe
5. Intake manifold
6. Exhaust manifold
7. Choke stove pipe
8. Manifold gasket (intake-to-exhaust)
9. Sleeve
10. Union

Manifold components—8R-C and 18R-C

1. Distributor drive gear
2. Cam sprocket
3. Timing chain cover
4. Chain damper #2
5. Chain damper #1



6. Crankshaft pulley
7. Pump drive spline
8. Crankshaft sprocket
9. Chain tensioner
10. Timing chain

20R timing chain cover and components

7. On 8R-C and 18R-C engines only remove the fan and water pump as an assembly.

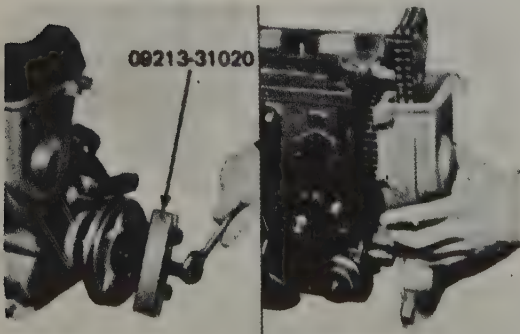
CAUTION: To prevent the fluid from running out of the fan coupling, do not tip the unit on its side.

8. Remove the center bolt on the crankshaft pulley. Using a gear puller, remove the crankshaft pulley.

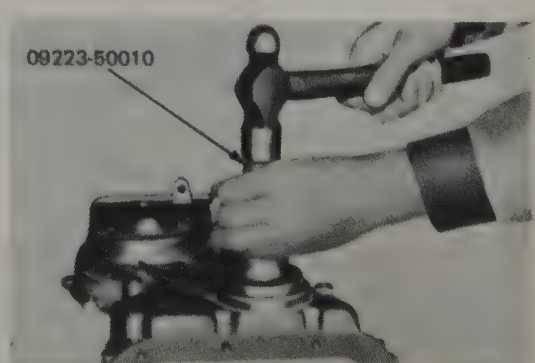
CAUTION: Do not remove the 10 mm bolt from the hole in the pulley, if present. It has been installed to correctly balance the engine.

9. On 8R-C and 18R-C engines, remove the eight bolts securing the timing chain cover, and remove the cover. On 20R and 22R engines, remove the 2 water bypass tube bolts, the one bolt at the rear of the cover on the left side (behind the coolant inlet pipe), and the six bolts on the front of the timing cover. Gently tap the timing cover off with a plastic faced hammer. If removal is difficult, there is probably a bolt still in place.

10. When installing, use a new gasket on the timing cover and oil pan. Use sealer at the corners of the oil pan. Tighten the timing



Removing the crankshaft pulley and the timing chain cover—8R-C and 18R-C



Installing the timing case cover oil seal

cover bolts to 11–15 ft. lbs. on 8R-C and 18R-C engines, 7–12 ft. lbs. on 20R and 22R engines. Tighten the oil pan bolts to 35–70 in. lbs.

11. Install the crankshaft pulley. On 8R-C and 18R-C engines, it will probably have to be driven on with a large socket or pipe. Make certain that the pulley TDC groove is aligned with the timing cover pointer. Tighten the pulley bolt to 43–51 ft. lbs. on the 8R-C, and 54–80 ft. lbs. on the 18R-C. On 20R and 22R engines, install the crankshaft pulley over the key. Tighten the bolt to 80–94 ft. lbs.

CAUTION: Do not allow the pulley to rotate when tightening the pulley bolt.

12. Further installation is the reverse of removal.

OIL SEAL REPLACEMENT

1. Remove the timing chain cover.
2. Pry the old oil seal out, using a large, flat-bladed screwdriver. Be careful not to damage the lip of the cover.
3. Place the cover on a flat surface, face up. Lubricate the new seal with grease, and drive it into place with a large socket, pipe, or block of wood. The seal can be damaged easily so work carefully. Install the seal so that it is flush with the front of the cover.
4. Install the timing chain cover as previously outlined.

Timing Chain and Tensioner

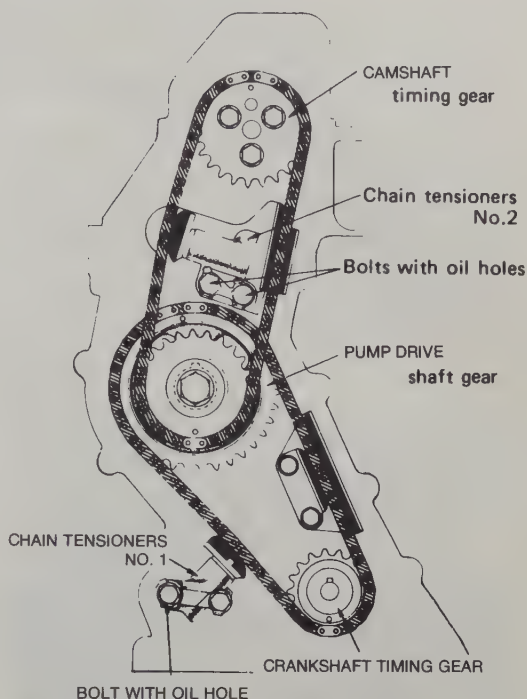
REMOVAL AND INSTALLATION

8R-C and 18R-C

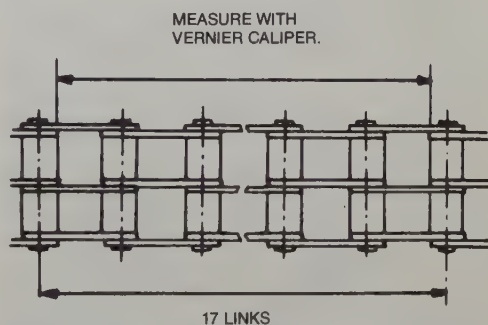
1. Remove the timing chain cover and the cylinder head as outlined earlier in this chapter.
2. Remove the chain tensioners (numbered 1 and 2 in the drawing). Keep the parts separated to avoid intermixing.
3. The upper timing chain and camshaft sprocket are removed with the cylinder head. Remove the camshaft drive gear next, using a gear puller. This is the gear in front of the pump drive shaft gear.
4. Remove the pump drive shaft gear, crankshaft timing gear, and chain as a unit, by using a gear puller alternately on the gears, working them evenly off the shafts.

CAUTION: Both timing chains are identical. They should be tagged so that they may be installed correctly.

5. Inspect the chains and sprockets for wear or damage. Clean the chains thoroughly with solvent.



Timing chain and gear relationship—8R-C and 18R-C



Timing chain stretch measurement—8R-C and 18R-C

6. Use a vernier caliper to measure the amount of stretch in both chains. Measure a span of any 17 links while the chain is pulled taut.

7. Repeat Step 5 at two other places along the chains. If any of the 17-link measurements exceeds 5.792 in. or if the difference between the maximum and minimum reading is greater than 0.0078 in., the chain should be replaced.

8. Remove the plunger and spring from one of the chain tensioners. Inspect all the parts of the tensioner mechanism for wear or damage. If there are no defective parts, fill the unit with oil and reassemble it. Perform this inspection on both tensioners.

CAUTION: Do not get the parts from the two tensioners mixed.

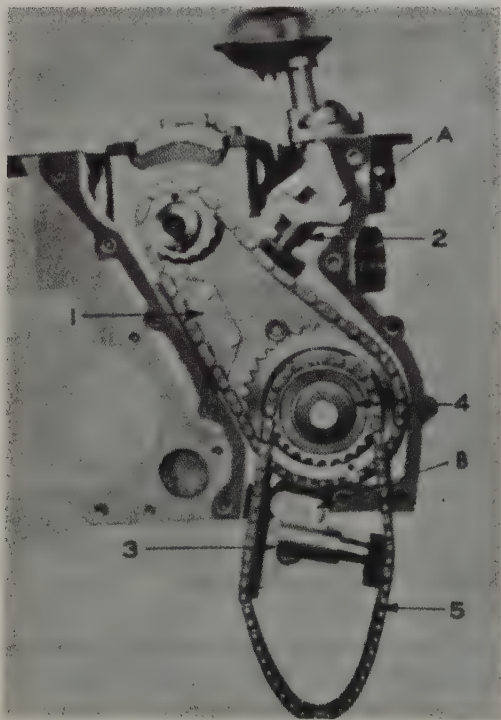
Installation is performed in the following manner.

1. When the keyway in the crankshaft is pointing straight up and is perpendicular to the cylinder head, the No. 1 piston is at top dead center (TDC). Turn the engine by hand to achieve this configuration.

2. Align the oil pump jackshaft so that its keyway is facing in the same direction as that on the crankshaft.

3. Align the marks on the timing sprocket and the oil pump drive sprocket with each of the marks on the chain.

4. Install the chain and sprocket assembly over the keyways, while retaining alignment of the chain/sprocket timing marks.



- A. Chain tensioner bolt
- B. Chain tensioner bolt
- 1. Chain vibration damper
- 2. Chain tensioner (oil pump drive chain)
- 3. Chain tensioner (camshaft timing chain)
- 4. Camshaft drive sprocket
- 5. Camshaft timing chain

Timing chain installation (engine inverted)—8R-C and 18R-C

CAUTION: Use care not to disengage the plug at the rear of the oil pump driveshaft, by forcing the sprocket over its keyway.

5. Install the oil pump drive chain vibration damper.

6. Install the gasket for the timing chain cover.

NOTE: Use liquid sealer on the gasket before installation.

7. Install both the chain tensioners in their respective places, being careful not to mix them up. Tighten their securing bolts to 12–17 ft. lbs. for 8R-C engines. On 18R-C engines, tighten No. 1 to 15–22 ft. lbs., and No. 2 to 22–29 ft. lbs. Use liquid sealer on the threads of the bolts without drilled oil holes.

CAUTION: Use care when installing the chain tensioner bolts; they have oil holes tapped in them.

NOTE: If oil remains in the body of tensioner No. 2, it will be difficult to install the camshaft timing gear. If the plunger does not sink when pressed, loosen the bolts holding the vibration damper and drain out the oil.

8. Fit the camshaft drive sprocket over the keyway on the oil pump drive-shaft. Tighten its securing nut to 58–72 ft. lbs.

9. Install the camshaft drive chain over the camshaft drive sprocket. Align the mating marks on the chain and sprocket.

10. Apply tension to the chain by tying it to the chain tensioner. This will prevent it from falling back into the timing chain cover once it is installed.

11. Install the timing chain cover and cylinder head as outlined above.

20R and 22R

1. Remove the cylinder head and timing chain cover as previously outlined.

2. Remove the chain from the dampers and remove the chain and cam sprocket together.

3. If the chain and sprocket are worn, they will have to be replaced, along with the crankshaft sprocket. Pull the crankshaft sprocket and pump drive spline as a unit, using a gear puller.

4. Measure the chain tensioner for wear. If it is worn below 0.43 in., replace it as a unit.

5. Measure the chain dampers for wear. If either is visibly worn or measures below the limit, replace as a unit.

Damper #1 0.20 in.

Damper #2 0.18 in.

To install:

1. After installing any necessary dampers

or a new tensioner, turn the crankshaft by hand until the key is at TDC. If removed, slide the crankshaft sprocket over the key. Place the chain on the sprocket so that the single bright link is over the mark on the sprocket.

2. Position the cam sprocket in the chain so that the timing mark on the sprocket is located between the two bright links of the chain.

3. Install the oil pump drive spline over the crankshaft key, if removed.

4. After cleaning the old gasket surface thoroughly, install a new cover gasket over the locating dowels.

5. Turn the camshaft sprocket counterclockwise to take any slack out of the chain.

6. Install the timing chain cover and cylinder head as previously outlined.

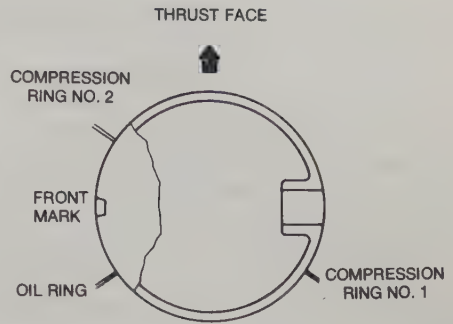
Camshaft

All engines utilize a chain-driven overhead camshaft (OHC). Therefore, the procedure for removing the camshaft is given as part of the cylinder head removal procedure for 8R-C and 18R-C engines, and in the Valve Service section for 20R and 22R engines.

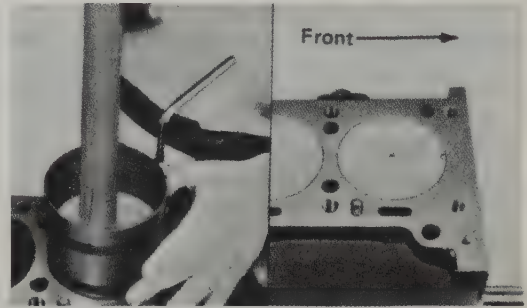
NOTE: It is not necessary to remove the cylinder head in order to remove the camshaft.

Pistons and Connecting Rods REMOVAL AND INSTALLATION

Procedures for piston, piston ring, and connecting rod removal, inspection, and installation will be found in the Engine Rebuilding section at the end of this Chapter. Crankshaft and connecting rod bearing and torque specifications can be found in the charts earlier in this Chapter. The connecting rod journals on the crankshaft should be measured; if they



Position of piston ring gaps



Installing the piston. The indentation faces to the front on the engine

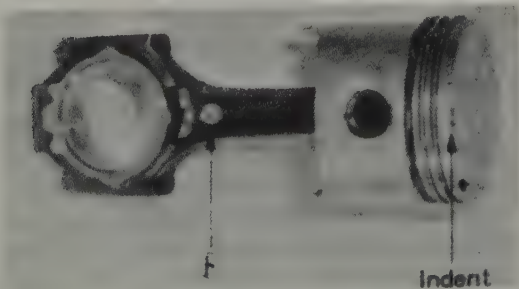
are more than 0.0004 in. out-of-round, the crankshaft should be removed and sent to a machine shop for regrinding, and the bearings should be replaced with the proper undersize units. Proper piston ring, piston, and connecting rod assembly relationships are illustrated here. These illustrations apply to all 90 engines.

ENGINE LUBRICATION

Oil Pan

REMOVAL AND INSTALLATION

1. Raise the hood and leave it open for the duration of this repair.
2. Drain the engine oil.
3. Raise the front end of the truck and support it on jackstands.
4. Remove the steering relay rod and the tie-rods from the idler arm, pitman arm, and steering knuckles as outlined in Chapter 8.
5. Remove the engine stiffening plates.
6. Remove the splash pans from under the engine.
7. Support the front of the engine with a jack and remove the front motor mount attaching bolts.



Piston and connecting rod assembly marks. The mark on the rod must face in the same direction of the indentation on the piston

- 8. Raise the front of the engine slightly with the jack.
- 9. Remove the oil pan bolts and remove the oil pan.
- 10. The installation process is the reverse of removal. Apply gasket sealer to the oil pan when installing a new gasket. The oil pan bolts should be tightened to 3–5 ft. lbs., 8R-C and 18R-C engines; 33–70 in. lbs. for 20R engines. Tighten the bolts in a circular pattern, starting in the middle of the pan and working out toward the ends.

Rear Main Oil Seal

REPLACEMENT

- NOTE: This procedure should not be attempted on trucks equipped with an automatic transmission.
- 1. Refer to Chapter 6 for instructions on removal of the transmission. Remove the transmission.
 - 2. Remove the clutch cover assembly and the flywheel. This procedure is also covered in Chapter 6.
 - 3. Remove the oil seal retaining plate along with the seal.
 - 4. Pry or drive the old seal from the retaining plate. Be careful not to damage the retaining plate.
 - 5. Install a new oil seal using either a block of wood or a seal driver to firmly seat the new seal.
 - 6. Lubricate the lips of the seal with multipurpose grease.
 - 7. Install the retaining plate and seal. Install the flywheel, clutch cover assembly, and transmission.
 - 8. Adjust the clutch.

Oil Pump

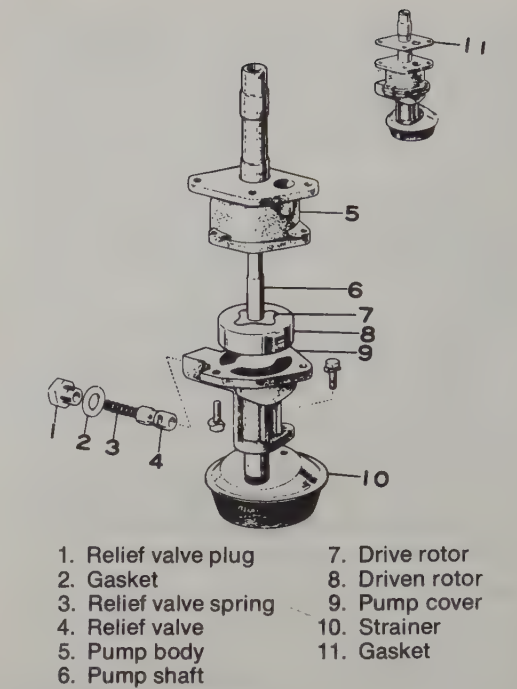
REMOVAL AND INSTALLATION

8R-C and 18R-C

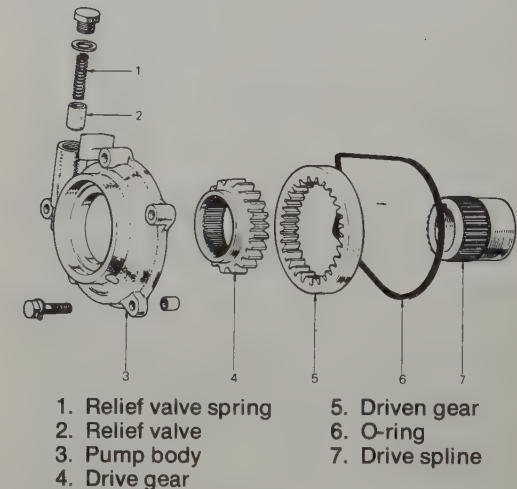
- 1. Remove the oil pan.
- 2. Unbolt the oil pump attaching bolts and remove the entire assembly.
- 3. Installation requires no special procedures. Simply position the pump and reinstall the attaching bolts. Replace the oil pan.
- 4. Fill the engine with clean engine oil.

20R and 22R

- 1. Drain the oil, and remove the oil pan and the oil strainer and pick-up tube.
- 2. Remove the drive belts from the crankshaft pulley.



8R-C and 18R-C oil pump

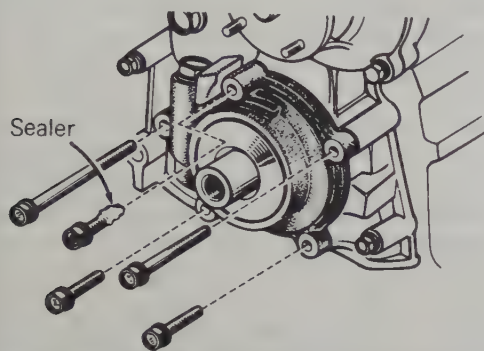


20R oil pump, 22R similar

- 3. Remove the crankshaft bolt, and remove the pulley with a gear puller, as outlined in the timing chain cover section.
- 4. Remove the five bolts from the oil pump and remove the oil pump assembly.
- Inspect the drive spline, driven gear, pump body, and timing chain cover for excessive wear or damage. If necessary, replace the gears or pump body or cover. Unbolt the relief valve (the vertical bolt on the pump body when attached to the engine) and check the piston, oil passages, and sliding surfaces

for burrs or scoring. Inspect the crankshaft front oil seal and replace if worn or damaged.

When installing, use a new O-ring if necessary. Apply sealer to the upper bolt and install the five bolts. Install the crankshaft pulley as outlined in the timing cover section, and use a new gasket on the oil strainer and oil pan. Be sure to apply sealer to the corners of the oil pan gasket before installing the pan.



Apply sealer to the upper bolt on the 20R oil pump

ENGINE COOLING

Coolant Changes

DRAINING, FLUSHING, AND REFILLING

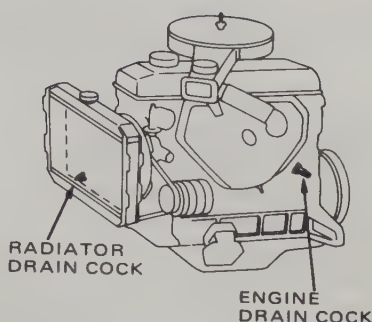
Once every 24 months or 24,000 miles, (1970–78), 24 months or 30,000 miles 1979 and later the cooling system should be drained, thoroughly flushed, and refilled. This should be done with the engine cold.

1. Remove the radiator cap.

2. There are two drain plugs in the cooling system; one at the bottom of the radiator and one of the rear of the driver's side of the engine. Both should be loosened to allow the coolant to drain.

3. Turn on the heater inside the truck to its hottest position. This ensures that the heater core is flushed out completely. Flush out the system thoroughly by refilling it with clean water through the radiator opening as it escapes from the two drain cocks. Continue until the water running out is clear. Be sure to clean out the coolant recovery tank as well if your truck has one.

4. If the system is badly contaminated with rust or scale, you can use a commercial flushing solution to clear it out. Some causes of rust are air in the system, caused by a leaky radiator cap or an insufficiently filled or leaking system, failure to change the coolant



Location of 20R drain plugs—other trucks similar

regularly, use of excessively hard or soft water, and failure to use a proper mix of antifreeze and water.

5. When the system is clear, allow all the water to drain, then close the drain plugs. Fill the system through the radiator with a 50/50 mix of ethylene glycol type antifreeze and water.

6. Start the engine and top off the radiator with water. If your truck has a coolant recovery tank, fill it half full with the coolant mix.

7. Replace the radiator and coolant tank caps, and check for leaks.

Radiator

REMOVAL AND INSTALLATION

1. Drain the cooling system completely by removing the lower and then the upper radiator hoses.

2. If the vehicle is equipped with an automatic transmission, remove the cooling lines from the bottom of the radiator.

NOTE: Use care when removing the cooling lines; the compression fittings are easily damaged as is the radiator. If available use special "flare nut wrenches" on the fittings. **CAUTION:** Do not allow dirt or water to enter the cooling lines!

3. Detach the hood lock cable and remove the hood lock from the radiator upper support. It may be necessary to remove the grille in order to gain access to the hood lock/radiator support assembly.

4. Remove the fan shroud.

5. Remove the radiator upper support.

6. Unfasten the retaining bolts and remove the radiator.

CAUTION: Do not damage the cooling fins on the radiator when withdrawing it from the engine compartment.

7. Reverse the procedure to install. Make sure that you check the fluid level of the au-

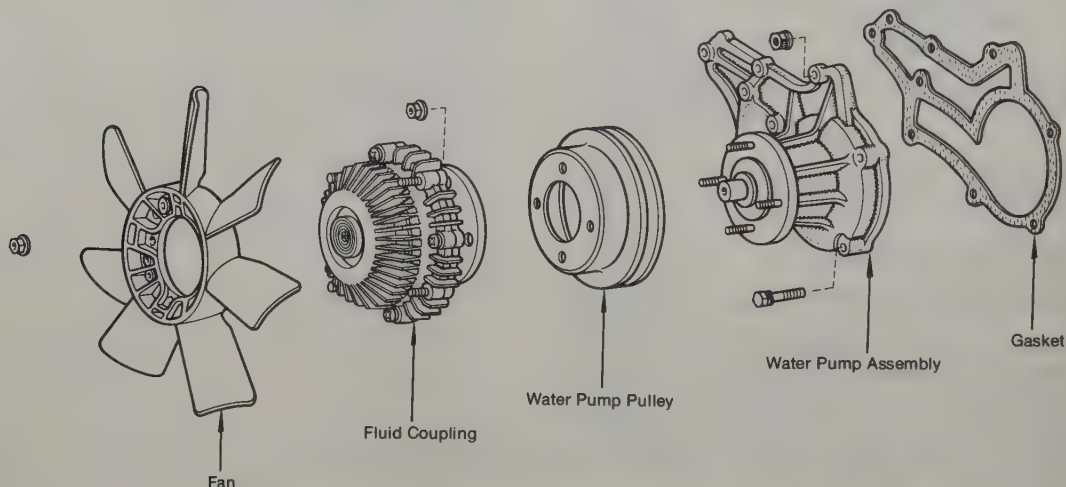
tomatic transmission before using the vehicle. See Chapter 1 for applicable procedures.

Water Pump

REMOVAL AND INSTALLATION

1. Drain the cooling system.
2. Remove the fan shroud.
3. Loosen the alternator adjusting link and remove the drive belt.
4. Remove the drive belt from the air pump if so equipped.
5. Remove the by-pass hose from the water pump.
6. Take the retaining bolts out of the water pump and remove the pump with the fan.

NOTE: *If the fan is equipped with a fluid coupling be careful not to tip the assembly as the fluid will spill out.*



Water pump—exploded view



Open radiator and engine drain cocks. Allow coolant to drain into a suitable container

7. Use a new gasket between the water pump and the block when installing the unit. Try not to get a lot of sealer behind the pump.

Thermostat

1. Partially drain the cooling system.
2. Unless the upper radiator hose is positioned over one of the thermostat housing (water outlet) bolts, it is not necessary to detach the hose.
3. Remove the bolts and remove the water outlet.
4. When installing a new thermostat always use a new gasket. Be sure that the thermostat is positioned with the spring down. The factory recommended thermostat temperature is 180° for all engines.

ENGINE REBUILDING

Most procedures involved in rebuilding an engine are fairly standard, regardless of the type of engine involved. This section is a guide to accepted rebuilding procedures. Examples of standard rebuilding practices are illustrated and should be used along with specific details concerning your particular engine, found earlier in this chapter.

The procedures given here are those used by any competent rebuilders. Obviously some of the procedures cannot be performed by the do-it-yourself mechanic, but are provided so that you will be familiar with the services that should be offered by rebuilding or machine shops. As an example, in most instances, it is more profitable for the home mechanic to remove the cylinder heads, buy the necessary parts (new valves, seals, keepers, keys, etc.) and deliver these to a machine shop for the necessary work. In this way you will save the money to remove and install the cylinder head and the mark-up on parts.

On the other hand, most of the work involved in rebuilding the lower end is well within the scope of the do-it-yourself mechanic. Only work such as hot-tanking, actually boring the block or Magnafluxing (invisible crack detection) need be sent to a machine shop.

Tools

The tools required for basic engine rebuilding should, with a few exceptions, be those included in a mechanic's tool kit. An accurate torque wrench, and a dial indicator (reading in thousandths) mounted on a universal base should be available. Special tools, where required, are available from the major tool suppliers. The services of a competent automotive machine shop must also be readily available.

Precautions

Aluminum has become increasingly popular for use in engines, due to its low weight and excellent heat transfer characteristics. The following precautions must be observed when handling aluminum (or any other) engine parts:

- Never hot-tank aluminum parts.
- Remove all aluminum parts (identification tags, etc.) from engine parts before hot-tanking (otherwise they will be removed during the process).

—Always coat threads lightly with engine oil or anti-seize compounds before installation, to prevent seizure.

—Never over-torque bolts or spark plugs in aluminum threads. Should stripping occur, threads can be restored using any of a number of thread repair kits available (see next section).

Inspection Techniques

Magnaflux and Zyglo are inspection techniques used to locate material flaws, such as stress cracks. Magnaflux is a magnetic process, applicable only to ferrous materials. The Zyglo process coats the material with a fluorescent dye penetrant, and any material may be tested using Zyglo. Specific checks of suspected surface cracks may be made at lower cost and more readily using spot check dye. The dye is sprayed onto the suspected area, wiped off, and the area is then sprayed with a developer. Cracks then will show up brightly.

Overhaul

The section is divided into two parts. The first, Cylinder Head Reconditioning, assumes that the cylinder head is removed from the engine, all manifolds are removed, and the cylinder head is on a workbench. The camshaft should be removed from overhead cam cylinder heads. The second section, Cylinder Block Reconditioning, covers the block, pistons, connecting rods and crankshaft. It is assumed that the engine is mounted on a work stand, and the cylinder head and all accessories are removed.

Procedures are identified as follows:

Unmarked—Basic procedures that must be performed in order to successfully complete the rebuilding process.

Starred ()*—Procedures that should be performed to ensure maximum performance and engine life.

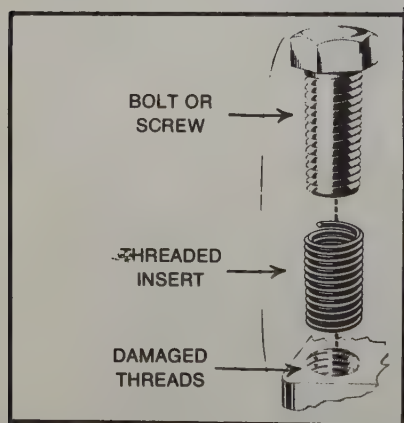
*Double starred (**)*—Procedures that may be performed to increase engine performance and reliability.

When assembling the engine, any parts that will be in frictional contact must be pre-lubricated, to provide protection on initial start-up. Any product specifically formulated for this purpose may be used. **NOTE: Do not use engine oil.** Where semi-permanent (locked but removable) installation of bolts or nuts is desired, threads should be cleaned and located with Loctite® or a similar product (non-hardening).

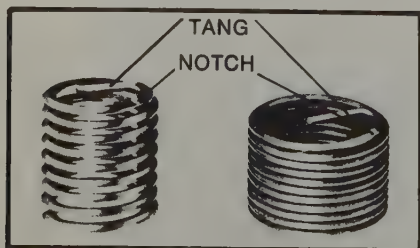
Repairing Damaged Threads

Several methods of repairing damaged threads are available. Heli-Coil® (shown here), Keenserts® and Microdot® are among the most widely used. All involve basically the same principle—drilling out stripped threads, tapping the hole and installing a pre-wound insert—making welding, plugging and oversize fasteners unnecessary.

Two types of thread repair inserts are usually supplied—a standard type for most Inch Coarse, Inch Fine, Metric Coarse and Metric Fine thread sizes and a spark plug type to fit most spark plug port sizes. Consult the individual manufacturer's catalog to determine exact applications. Typical thread repair kits will contain a selection of pre-wound threaded inserts, a tap (corresponding to the outside diameter threads of the insert) and an installation tool. Spark plug inserts usually differ because they require a tap equipped with pilot threads and a combined reamer/tap section. Most manufacturers also supply blister-packed thread repair inserts separately in addition to a master kit containing a variety of taps and inserts plus installation tools.



Damaged bolt holes can be repaired with thread repair inserts

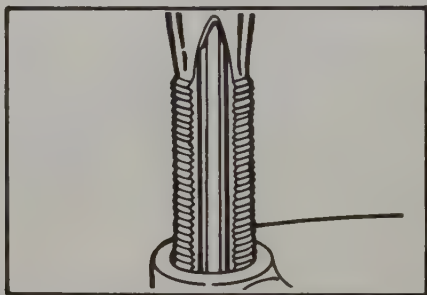


Standard thread repair insert (left) and spark plug thread insert (right)

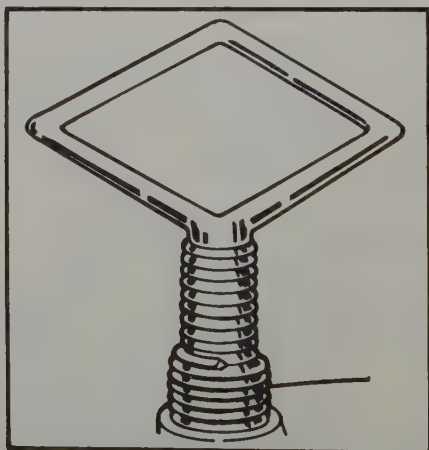
Before effecting a repair to a threaded hole, remove any snapped, broken or damaged bolts or studs. Penetrating oil can be used to free frozen threads; the offending item can be removed with locking pliers or with a screw or stud extractor. After the hole is clear, the thread can be repaired, as follows:



Drill out the damaged threads with specified drill. Drill completely through the hole or to the bottom of a blind hole



With the tap supplied, tap the hole to receive the thread insert. Keep the tap well oiled and back it out frequently to avoid clogging the threads



Screw the threaded insert onto the installation tool until the tang engages the slot. Screw the insert into the tapped hole until it is $\frac{1}{4}$ – $\frac{1}{2}$ turn below the top surface. After installation break off the tang with a hammer and punch

Standard Torque Specifications and Fastener Markings

The Newton-metre has been designated the world standard for measuring torque and will gradually replace the foot-pound and kilogram-meter. In the absence of specific torques, the following chart can be used as a guide to the maximum safe torque of a particular size/grade of fastener.

- There is no torque difference for fine or coarse threads.
- Torque values are based on clean, dry threads. Reduce the value by 10% if threads are oiled prior to assembly.
- The torque required for aluminum components or fasteners is considerably less.

U. S. BOLTS

SAE Grade Number	1 or 2			5			6 or 7		
Bolt Markings									
Manufacturer's marks may vary—number of lines always 2 less than the grade number.									
Usage	Frequent			Frequent			Infrequent		
Bolt Size (inches)—(Thread)	Maximum Torque			Maximum Torque			Maximum Torque		
	Ft-Lb	kgm	Nm	Ft-Lb	kgm	Nm	Ft-Lb	kgm	Nm
1/4—20	5	0.7	6.8	8	1.1	10.8	10	1.4	13.5
—28	6	0.8	8.1	10	1.4	13.6			
5/16—18	11	1.5	14.9	17	2.3	23.0	19	2.6	25.8
—24	13	1.8	17.6	19	2.6	25.7			
3/8—16	18	2.5	24.4	31	4.3	42.0	34	4.7	46.0
—24	20	2.75	27.1	35	4.8	47.5			
7/16—14	28	3.8	37.0	49	6.8	66.4	55	7.6	74.5
—20	30	4.2	40.7	55	7.6	74.5			
1/2—13	39	5.4	52.8	75	10.4	101.7	85	11.75	115.2
—20	41	5.7	55.6	85	11.7	115.2			
9/16—12	51	7.0	69.2	110	15.2	149.1	120	16.6	162.7
—18	55	7.6	74.5	120	16.6	162.7			
5/8—11	83	11.5	112.5	150	20.7	203.3	167	23.0	226.5
—18	95	13.1	128.8	170	23.5	230.5			
3/4—10	105	14.5	142.3	270	37.3	366.0	280	38.7	379.6
—16	115	15.9	155.9	295	40.8	400.0			
7/8—9	160	22.1	216.9	395	54.6	535.5	440	60.9	596.5
—14	175	24.2	237.2	435	60.1	589.7			
1—8	236	32.5	318.6	590	81.6	799.9	660	91.3	894.8
—14	250	34.6	338.9	660	91.3	849.8			

METRIC BOLTS

NOTE: Metric bolts are marked with a number indicating the relative strength of the bolt. These numbers have nothing to do with size.

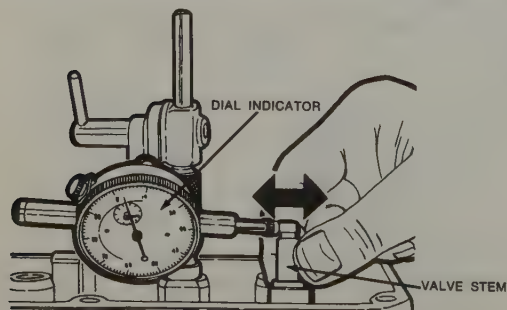
Description Thread size x pitch (mm)	Torque ft-lbs (Nm)			
	Head mark—4		Head mark—7	
6 x 1.0	2.2–2.9	(3.0–3.9)	3.6–5.8	(4.9–7.8)
8 x 1.25	5.8–8.7	(7.9–12)	9.4–14	(13–19)
10 x 1.25	12–17	(16–23)	20–29	(27–39)
12 x 1.25	21–32	(29–43)	35–53	(47–72)
14 x 1.5	35–52	(48–70)	57–85	(77–110)
16 x 1.5	51–77	(67–100)	90–120	(130–160)
18 x 1.5	74–110	(100–150)	130–170	(180–230)
20 x 1.5	110–140	(150–190)	190–240	(160–320)
22 x 1.5	150–190	(200–260)	250–320	(340–430)
24 x 1.5	190–240	(260–320)	310–410	(420–550)

NOTE: This engine rebuilding section is a guide to accepted rebuilding procedures. Typical examples of standard rebuilding procedures are illustrated. Use these procedures along with the detailed instructions earlier in this chapter, concerning your particular engine.

Cylinder Head Reconditioning

Procedure	Method
Remove the cylinder head:	See the engine service procedures earlier in this chapter for details concerning specific engines.
Identify the valves:	Invert the cylinder head, and number the valve faces front to rear, using a permanent felt-tip marker.
Remove the camshaft:	See the engine service procedures earlier in this chapter for details concerning specific engines.
Remove the valves and springs:	Using an appropriate valve spring compressor (depending on the configuration of the cylinder head), compress the valve springs. Lift out the keepers with needlenose pliers, release the compressor, and remove the valve, spring, and spring retainer. See the engine service procedures earlier in this chapter for details concerning specific engines.

Check the valve stem-to-guide clearance:



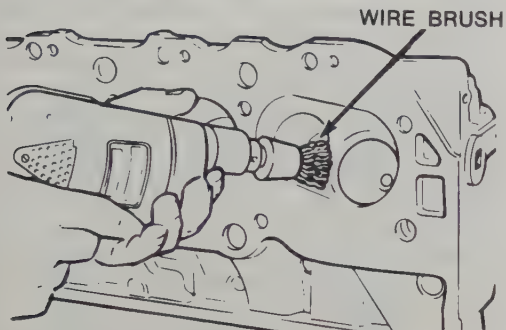
Check the valve stem-to-guide clearance

Clean the valve stem with lacquer thinner or a similar solvent to remove all gum and varnish. Clean the valve guides using solvent and an expanding wire-type valve guide cleaner. Mount a dial indicator so that the stem is at 90° to the valve stem, as close to the valve guide as possible. Move the valve off its seat, and measure the valve guide-to-stem clearance by rocking the stem back and forth to actuate the dial indicator. Measure the valve stems using a micrometer, and compare to specifications, to determine whether stem or guide wear is responsible for excessive clearance.
NOTE: Consult the Specifications tables earlier in this chapter.

Cylinder Head Reconditioning

Procedure

De-carbon the cylinder head and valves:



Remove the carbon from the cylinder head with a wire brush and electric drill

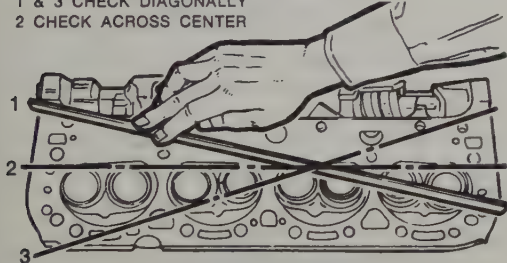
Hot-tank the cylinder head (cast iron heads only):

CAUTION: Do not hot-tank aluminum parts.

Degrease the remaining cylinder head parts:

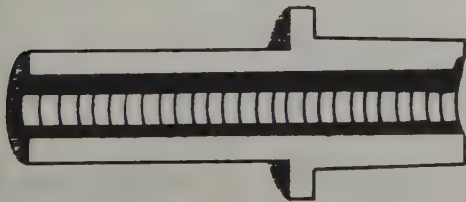
Check the cylinder head for warpage:

- 1 & 3 CHECK DIAGONALLY
- 2 CHECK ACROSS CENTER



Check the cylinder head for warpage

* Knurl the valve guides:



Cut-away view of a knurled valve guide

Replace the valve guides:

NOTE: Valve guides should only be replaced if damaged or if an oversize valve stem is not available.

Method

Chip carbon away from the valve heads, combustion chambers, and ports, using a chisel made of hardwood. Remove the remaining deposits with a stiff wire brush.

NOTE: Be sure that the deposits are actually removed, rather than burnished.

Have the cylinder head hot-tanked to remove grease, corrosion, and scale from the water passages.

NOTE: In the case of overhead cam cylinder heads, consult the operator to determine whether the camshaft bearings will be damaged by the caustic solution.

Clean the remaining cylinder head parts in an engine cleaning solvent. Do not remove the protective coating from the springs.

Place a straight-edge across the gasket surface of the cylinder head. Using feeler gauges, determine the clearance at the center of the straight-edge. If warpage exceeds .003" in a 6" span, or .006" over the total length, the cylinder head must be resurfaced.

NOTE: If warpage exceeds the manufacturer's maximum tolerance for material removal, the cylinder head must be replaced.

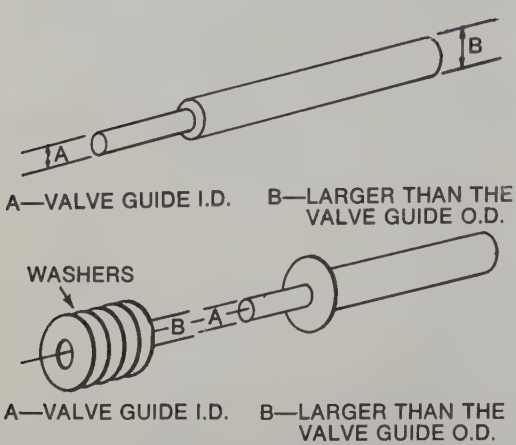
When milling the cylinder heads of V-type engines, the intake manifold mounting position is altered, and must be corrected by milling the manifold flange a proportionate amount.

* Valve guides which are not excessively worn or distorted may, in some cases, be knurled rather than replaced. Knurling is a process in which metal is displaced and raised, thereby reducing clearance. Knurling also provides excellent oil control. The possibility of knurling rather than replacing valve guides should be discussed with a machinist.

See the engine service procedures earlier in this chapter for details concerning specific engines. Depending on the type of cylinder head, valve guides may be pressed, hammered, or shrunk in. In cases where the guides are shrunk into the head, replacement should be left to an equipped machine shop. In other

Cylinder Head Reconditioning

Procedure	Method
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Valve guide installation tool using washers for installation

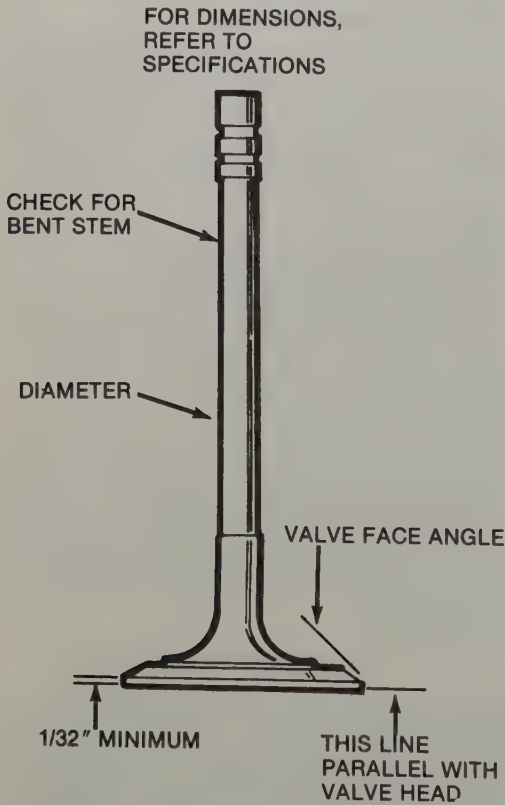
cases, the guides are replaced using a stepped drift (see illustration). Determine the height above the boss that the guide must extend, and obtain a stack of washers, their I.D. similar to the guide's O.D., of that height. Place the stack of washers on the guide, and insert the guide into the boss.

NOTE: *Valve guides are often tapered or beveled for installation.* Using the stepped installation tool (see illustration), press or tap the guides into position. Ream the guides according to the size of the valve stem.

Replace valve seat inserts:

Replacement of valve seat inserts which are worn beyond resurfacing or broken, if feasible, must be done by a machine shop.

Resurface (grind) the valve face:

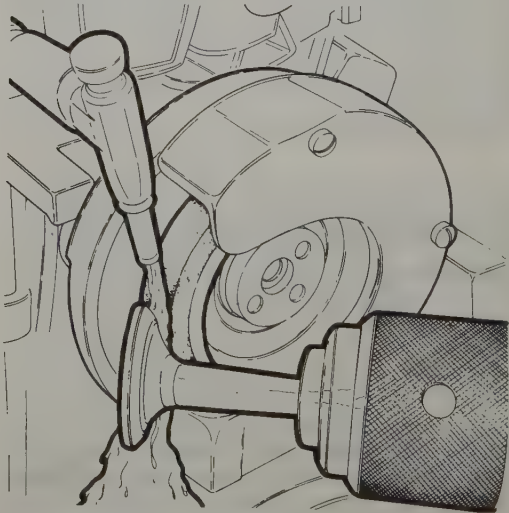


Critical valve dimensions

Using a valve grinder, resurface the valves according to specifications given earlier in this chapter.

CAUTION: *Valve face angle is not always identical to valve seat angle.* A minimum margin of 1/32" should remain after grinding the valve. The valve stem top should also be squared and resurfaced, by placing the stem in the V-block of the grinder, and turning it while pressing lightly against the grinding wheel.

NOTE: *Do not grind sodium filled exhaust valves on a machine. These should be hand lapped.*

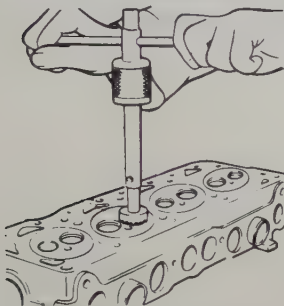
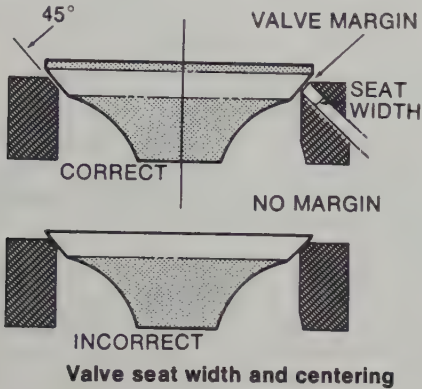


Valve grinding by machine

Cylinder Head Reconditioning

Procedure

Resurface the valve seats using reamers or grinder:



Reaming the valve seat with a hand reamer

Method

Select a reamer of the correct seat angle, slightly larger than the diameter of the valve seat, and assemble it with a pilot of the correct size. Install the pilot into the valve guide, and using steady pressure, turn the reamer clockwise.

CAUTION: Do not turn the reamer counterclockwise. Remove only as much material as necessary to clean the seat. Check the concentricity of the seat (following). If the dye method is not used, coat the valve face with Prussian blue dye, install and rotate it on the valve seat. Using the dye marked area as a centering guide, center and narrow the valve seat to specifications with correction cutters.

NOTE: When no specifications are available, minimum seat width for exhaust valves should be $\frac{5}{64}$ ", intake valves $\frac{1}{16}$ ".

After making correction cuts, check the position of the valve seat on the valve face using Prussian blue dye.

To resurface the seat with a power grinder, select a pilot of the correct size and coarse stone of the proper angle. Lubricate the pilot and move the stone on and off the valve seat at 2 cycles per second, until all flaws are gone. Finish the seat with a fine stone. If necessary the seat can be corrected or narrowed using correction stones.

Check the valve seat concentricity:

Coat the valve face with Prussian blue dye, install the valve, and rotate it on the valve seat. If the entire seat becomes coated, and the valve is known to be concentric, the seat is concentric.

* Install the dial gauge pilot into the guide, and rest of the arm on the valve seat. Zero the gauge, and rotate the arm around the seat. Run-out should not exceed .002".



Check the valve seat concentricity with a dial gauge

Cylinder Head Reconditioning

Procedure	Method
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***Lap the valves:**
NOTE: *Valve lapping is done to ensure efficient sealing of resurfaced valves and seats.*



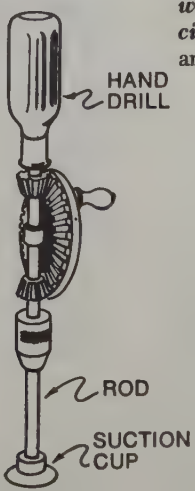
Lapping the valves by hand

Invert the cylinder head, lightly lubricate the valve stems, and install the valves in the head as numbered. Coat valve seats with fine grinding compound, and attach the lapping tool suction cup to a valve head.

NOTE: *Moisten the suction cup.* Rotate the tool between the palms, changing position and lifting the tool often to prevent grooving. Lap the valve until a smooth, polished seat is evident. Remove the valve and tool, and rinse away all traces of grinding compound.

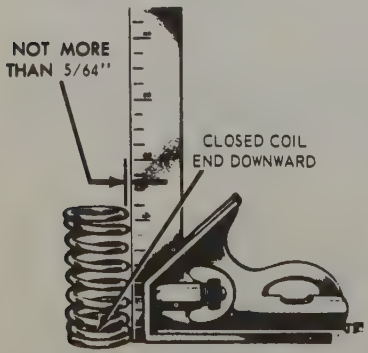
****** Fasten a suction cup to a piece of drill rod, and mount the rod in a hand drill. Proceed as above, using the hand drill as a lapping tool.

CAUTION: *Due to the higher speeds involved when using the hand drill, care must be exercised to avoid grooving the seat. Lift the tool and change direction of rotation often.*



Home-made valve lapping tool

Check the valve springs:



Check the valve spring free length and squareness

Place the spring on a flat surface next to a square. Measure the height of the spring, and rotate it against the edge of the square to measure distortion. If spring height varies (by comparison) by more than $\frac{1}{16}$ " or if distortion exceeds $\frac{1}{16}$ ", replace the spring.

****** In addition to evaluating the spring as above, test the spring pressure at the installed and compressed (installed height minus valve lift) height using a valve spring tester. Springs used on small displacement engines (up to 3 liters) should be ± 1 lb of all other springs in either position. A tolerance of ± 5 lbs is permissible on larger engines.

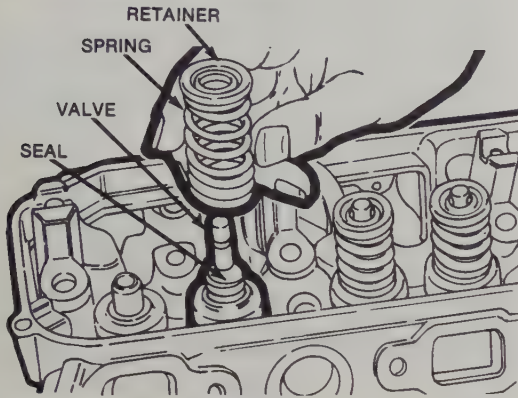


Check the valve spring test pressure

Cylinder Head Reconditioning

Procedure

Method

***Install valve stem seals:**

Install valve stem seals

* Due to the pressure differential that exists at the ends of the intake valve guides (atmospheric pressure above, manifold vacuum below), oil is drawn through the valve guides into the intake port. This has been alleviated somewhat since the addition of positive crankcase ventilation, which lowers the pressure above the guides. Several types of valve stem seals are available to reduce blow-by. Certain seals simply slip over the stem and guide boss, while others require that the boss be machined. Recently, Teflon guide seals have become popular. Consult a parts supplier or machinist concerning availability and suggested usages.

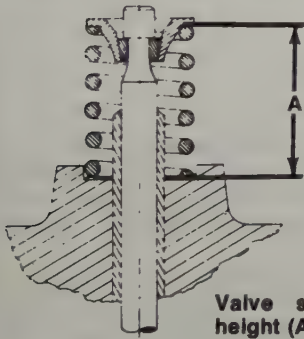
NOTE: When installing seals, ensure that a small amount of oil is able to pass the seal to lubricate the valve guides; otherwise, excessive wear may result.

Install the valves:

See the engine service procedures earlier in this chapter for details concerning specific engines.

Lubricate the valve stems, and install the valves in the cylinder head as numbered. Lubricate and position the seals (if used) and the valve springs. Install the spring retainers, compress the springs, and insert the keys using needlenose pliers or a tool designed for this purpose.

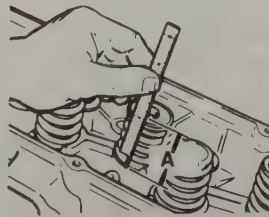
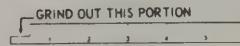
NOTE: Retain the keys with wheel bearing grease during installation.

Check valve spring installed height:

Valve spring installed height (A)

Measure the distance between the spring pad the lower edge of the spring retainer, and compare to specifications. If the installed height is incorrect, add shim washers between the spring pad and the spring.

CAUTION: Use only washers designed for this purpose.



Measure the valve spring installed height (A) with a modified steel rule

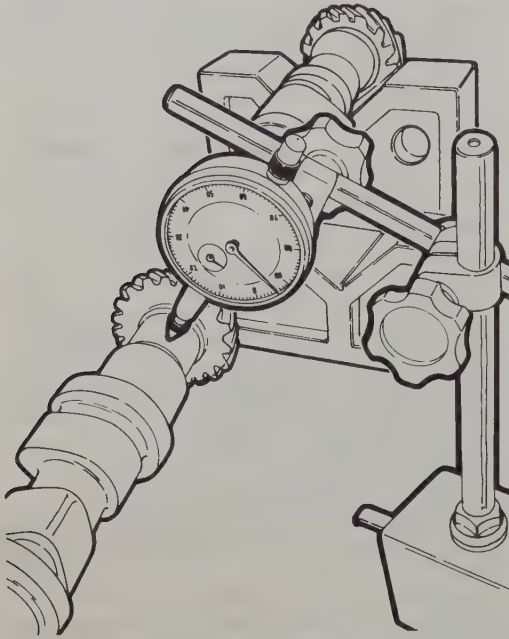
Clean and inspect the camshaft:

Degrease the camshaft, using solvent, and clean out all oil holes. Visually inspect cam lobes and bearing journals for excessive wear. If a lobe is questionable, check all lobes as indicated below. If a journal or lobe is worn, the camshaft must be reground or replaced.

Cylinder Head Reconditioning

Procedure

Method

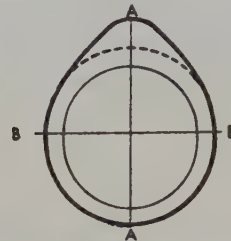


Check the camshaft for straightness

NOTE: If a journal is worn, there is a good chance that the bushings are worn.

If lobes and journals appear intact, place the front and rear journals in V-blocks, and rest a dial indicator on the center journal. Rotate the camshaft to check straightness. If deviation exceeds .001", replace the camshaft.

*Check the camshaft lobes with a micrometer, by measuring the lobes from the nose to base and again at 90° (see illustration). The lift is determined by subtracting the second measurement from the first. If all exhaust lobes and all intake lobes are not identical, the camshaft must be reground or replaced.



Camshaft lobe measurement

Install the camshaft:

See the engine service procedures earlier in this chapter for details concerning specific engines.

Install the rocker arms:

See the engine service procedures earlier in this chapter for details concerning specific engines.

Cylinder Block Reconditioning

Procedure

Method

Checking the main bearing clearance:

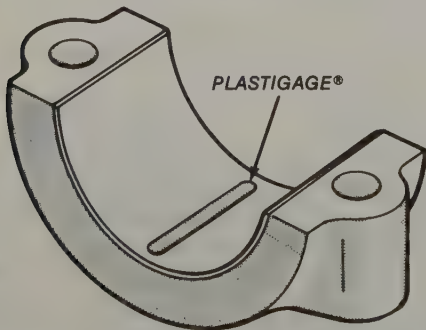
Invert engine, and remove cap from the bearing to be checked. Using a clean, dry rag, thoroughly clean all oil from crankshaft journal and bearing insert.

NOTE: Plastigage® is soluble in oil; therefore, oil on the journal or bearing could result in erroneous readings. Place a piece of Plastigage along the full length of journal, reinstall cap, and torque to specifications.

NOTE: Specifications are given in the engine specifications earlier in this chapter.

Remove bearing cap, and determine bearing clearance by comparing width of Plastigage to the scale on Plastigage envelope. Journal taper is determined by comparing width of the Plastigage strip near its ends. Rotate crankshaft 90° and retest, to determine journal eccentricity.

NOTE: Do not rotate crankshaft with Plastigage installed. If bearing insert and journal appear in-

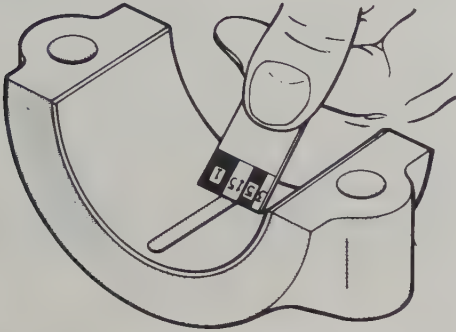


Plastigage® installed on the lower bearing shell

Cylinder Block Reconditioning

Procedure

Method



Measure Plastigage® to determine main bearing clearance

tact, and are within tolerances, no further main bearing service is required. If bearing or journal appear defective, cause of failure should be determined before replacement.

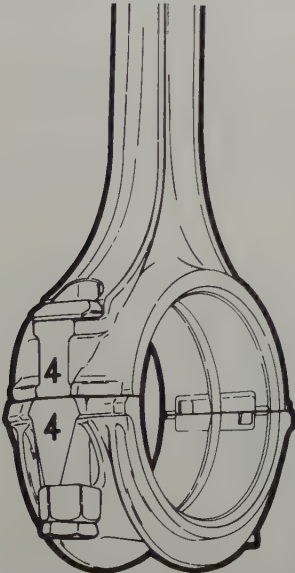
* Remove crankshaft from block (see below). Measure the main bearing journals at each end twice (90° apart) using a micrometer, to determine diameter, journal taper and eccentricity. If journals are within tolerances, reinstall bearing caps at their specified torque. Using a telescope gauge and micrometer, measure bearing I.D. parallel to piston axis and at 30° on each side of piston axis. Subtract journal O.D. from bearing I.D. to determine oil clearance. If crankshaft journals appear defective, or do not meet tolerances, there is no need to measure bearings; for the crankshaft will require grinding and/or undersize bearings will be required. If bearing appears defective, cause for failure should be determined prior to replacement.

Check the connecting rod bearing clearance:

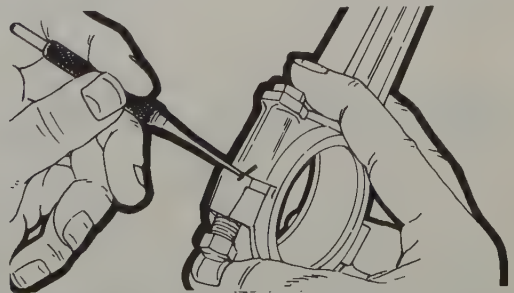
Connecting rod bearing clearance is checked in the same manner as main bearing clearance, using Plastigage. Before removing the crankshaft, connecting rod side clearance also should be measured and recorded.

* Checking connecting rod bearing clearance, using a micrometer, is identical to checking main bearing clearance. If no other service is required, the piston and rod assemblies need not be removed.

Remove the crankshaft:



Using a punch, mark the corresponding main bearing caps and saddles according to position (i.e., one punch on the front main cap and saddle, two on the second, three on the third, etc.). Using number stamps, identify the corresponding connecting rods and caps, according to cylinder (if no numbers are present). Remove the main and connecting rod caps, and replace sleeves of plastic tubing or vacuum hose over the connecting rod bolts, to protect the journals as the crankshaft is removed. Lift the crankshaft out of the block.



Match the connecting rod to the cylinder with a number stamp

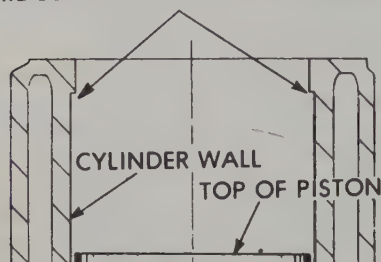
Match the connecting rod and cap with scribe marks

Cylinder Block Reconditioning

Procedure

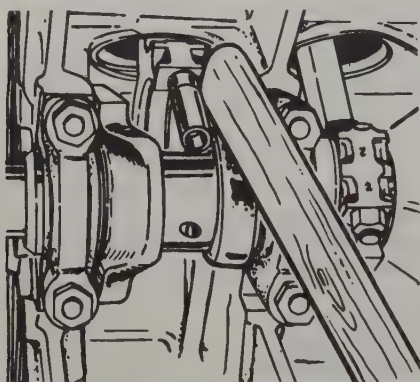
Remove the ridge from the top of the cylinder:

RIDGE CAUSED BY CYLINDER WEAR



Cylinder bore ridge

Remove the piston and connecting rod:



Push the piston out with a hammer handle

Service the crankshaft:

Method

In order to facilitate removal of the piston and connecting rod, the ridge at the top of the cylinder (unworn area; see illustration) must be removed. Place the piston at the bottom of the bore, and cover it with a rag. Cut the ridge away using a ridge reamer, exercising extreme care to avoid cutting too deeply. Remove the rag, and remove cuttings that remain on the piston.

CAUTION: If the ridge is not removed, and new rings are installed, damage to rings will result.

Invert the engine, and push the pistons and connecting rods out of the cylinders. If necessary, tap the connecting rod boss with a wooden hammer handle, to force the piston out.

CAUTION: Do not attempt to force the piston past the cylinder ridge (see above).

Ensure that all oil holes and passages in the crankshaft are open and free of sludge. If necessary, have the crankshaft ground to the largest possible undersize.

****** Have the crankshaft Magnafluxed, to locate stress cracks. Consult a machinist concerning additional service procedures, such as surface hardening (e.g., nitriding, Tuftriding) to improve wear characteristics, cross drilling and chamfering the oil holes to improve lubrication, and balancing.

Removing freeze plugs:

Drill a small hole in the middle of the freeze plugs. Thread a large sheet metal screw into the hole and remove the plug with a slide hammer.

Remove the oil gallery plugs:

Threaded plugs should be removed using an appropriate (usually square) wrench. To remove soft, pressed in plugs, drill a hole in the plug, and thread in a sheet metal screw. Pull the plug out by the screw using pliers.

Hot-tank the block:

NOTE: Do not hot-tank aluminum parts.

Have the block hot-tanked to remove grease, corrosion, and scale from the water jackets.

NOTE: Consult the operator to determine whether the camshaft bearings will be damaged during the hot-tank process.

Cylinder Block Reconditioning

Procedure

Check the block for cracks:

Method

Visually inspect the block for cracks or chips. The most common locations are as follows:

Adjacent to freeze plugs.

Between the cylinders and water jackets.

Adjacent to the main bearing saddles.

At the extreme bottom of the cylinders.

Check only suspected cracks using spot check dye (see introduction). If a crack is located, consult a machinist concerning possible repairs.

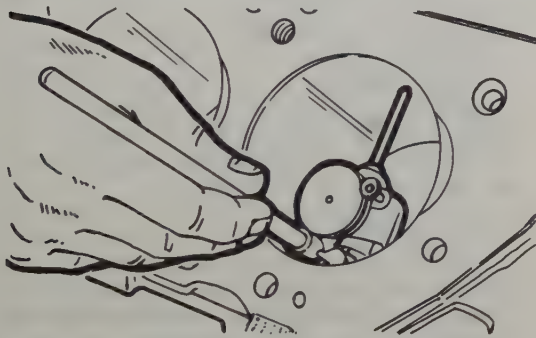
****** Magnaflux the block to locate hidden cracks. If cracks are located, consult a machinist about feasibility of repair.

Install the oil gallery plugs and freeze plugs:

Coat freeze plugs with sealer and tap into position using a piece of pipe, slightly smaller than the plug, as a driver. To ensure retention, stake the edges of the plugs. Coat threaded oil gallery plugs with sealer and install. Drive replacement soft plugs into block using a large drift as a driver.

***** Rather than reinstalling lead plugs, drill and tap the holes, and install threaded plugs.

Check the bore diameter and surface:



Measure the cylinder bore with a dial gauge

Visually inspect the cylinder bores for roughness, scoring, or scuffing. If evident, the cylinder bore must be bored or honed oversize to eliminate imperfections, and the smallest possible oversize piston used. The new pistons should be given to the machinist with the block, so that the cylinders can be bored or honed exactly to the piston size (plus clearance). If no flaws are evident, measure the bore diameter using a telescope gauge and micrometer, or dial gauge, parallel and perpendicular to the engine centerline, at the top (below the ridge) and bottom of the bore. Subtract the bottom measurements from the top to determine taper, and the parallel to the centerline measurements from the perpendicular measurements to determine eccentricity. If the measurements are not within specifications, the cylinder must be bored or honed, and an oversize piston installed. If the measurements are within specifications the cylinder may

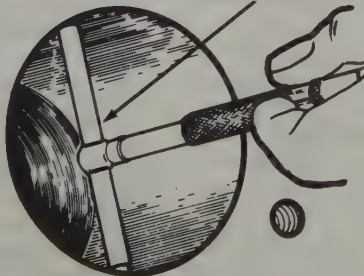
← CENTERLINE OF ENGINE →



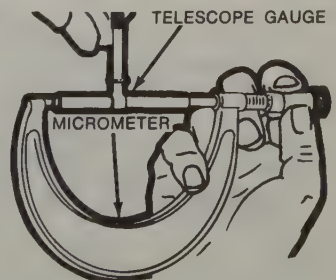
A—AT RIGHT ANGLE TO
CENTERLINE OF ENGINE
B—PARALLEL TO
CENTERLINE OF ENGINE

Cylinder bore measuring points

TELESCOPE GAUGE 90°
FROM PISTON PIN

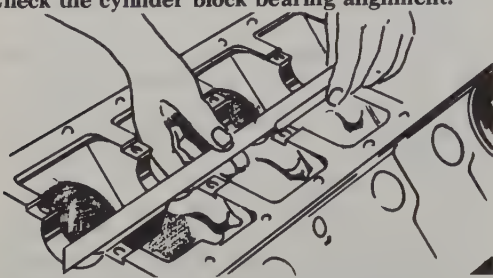
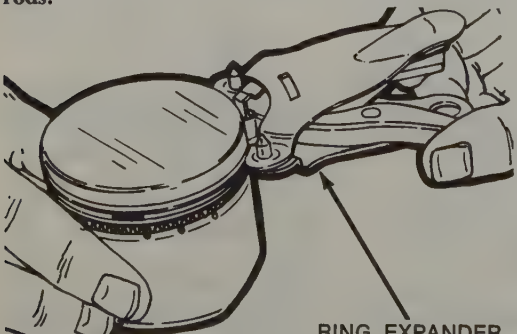


Measure the cylinder bore with a telescope gauge



Measure the telescope gauge with a micrometer to determine the cylinder bore

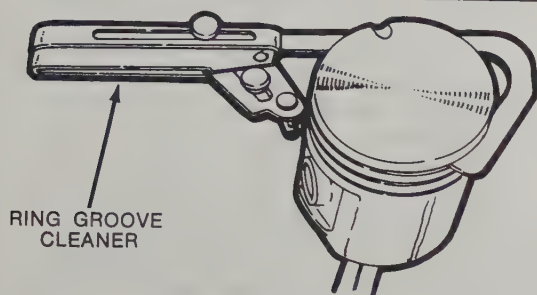
Cylinder Block Reconditioning

Procedure	Method
Check the cylinder block bearing alignment:  Check the main bearing saddle alignment	be used as is, with only finish honing (see below). NOTE: <i>Prior to submitting the block for boring, perform the following operation(s).</i> Remove the upper bearing inserts. Place a straightedge in the bearing saddles along the centerline of the crankshaft. If clearance exists between the straightedge and the center saddle, the block must be alignbored.
*Check the deck height:	The deck height is the distance from the crankshaft centerline to the block deck. To measure, invert the engine, and install the crankshaft, retaining it with the center maincap. Measure the distance from the crankshaft journal to the block deck, parallel to the cylinder centerline. Measure the diameter of the end (front and rear) main journals, parallel to the centerline of the cylinders, divide the diameter in half, and subtract it from the previous measurement. The results of the front and rear measurements should be identical. If the difference exceeds .005", the deck height should be corrected. NOTE: <i>Block deck height and warpage should be corrected at the same time.</i>
Check the block deck for warpage:	Using a straightedge and feeler gauges, check the block deck for warpage in the same manner that the cylinder head is checked (see Cylinder Head Reconditioning). If warpage exceeds specifications, have the deck resurfaced. NOTE: <i>In certain cases a specification for total material removal (cylinder head and block deck) is provided. This specification must not be exceeded.</i>
Clean and inspect the pistons and connecting rods:  Remove the piston rings	Using a ring expander, remove the rings from the piston. Remove the retaining rings (if so equipped) and remove piston pin. NOTE: <i>If the piston pin must be pressed out, determine the proper method and use the proper tools; otherwise the piston will distort.</i> Clean the ring grooves using an appropriate tool, exercising care to avoid cutting too deeply. Thoroughly clean all carbon and varnish from the piston with solvent. CAUTION: <i>Do not use a wire brush or caustic solvent on pistons.</i> Inspect the pistons for scuffing, scoring, cracks, pitting, or excessive ringsgroove wear. If wear is evident, the piston must be replaced. Check the connecting rod length by measuring

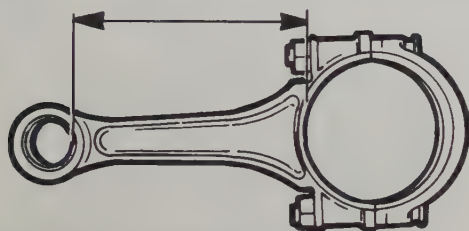
Cylinder Block Reconditioning

Procedure

Method

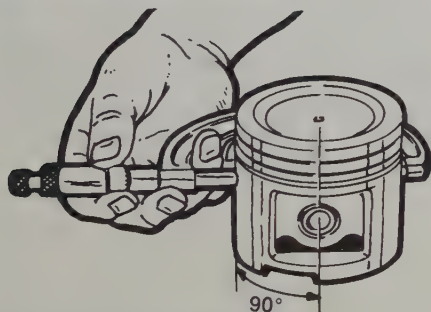


Clean the piston ring grooves



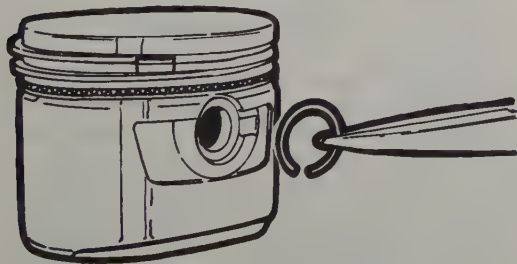
Check the connecting rod length (arrow)

Fit the pistons to the cylinders:



Measure the piston prior to fitting

Assemble the pistons and connecting rods:



Install the piston pin lock-rings (if used)

the rod from the inside of the large end to the inside of the small end using calipers (see illustration). All connecting rods should be equal length. Replace any rod that differs from the others in the engine.

* Have the connecting rod alignment checked in an alignment fixture by a machinist. Replace any twisted or bent rods.

* Magnaflux the connecting rods to locate stress cracks. If cracks are found, replace the connecting rod.

Using a telescope gauge and micrometer, or a dial gauge, measure the cylinder bore diameter perpendicular to the piston pin, $2\frac{1}{2}$ " below the deck. Measure the piston perpendicular to its pin on the skirt. The difference between the two measurements is the piston clearance. If the clearance is within specifications or slightly below (after boring or honing), finish honing is all that is required. If the clearance is excessive, try to obtain a slightly larger piston to bring clearance within specifications. Where this is not possible, obtain the first oversize piston, and hone (of if necessary, bore) the cylinder to size.

Inspect piston pin, connecting rod small end bushing, and piston bore for galling, scoring, or excessive wear. If evident, replace defective part(s). Measure the I.D. of the piston boss and connecting rod small end, and the O.D. of the piston pin. If within specifications, assemble piston pin and rod.

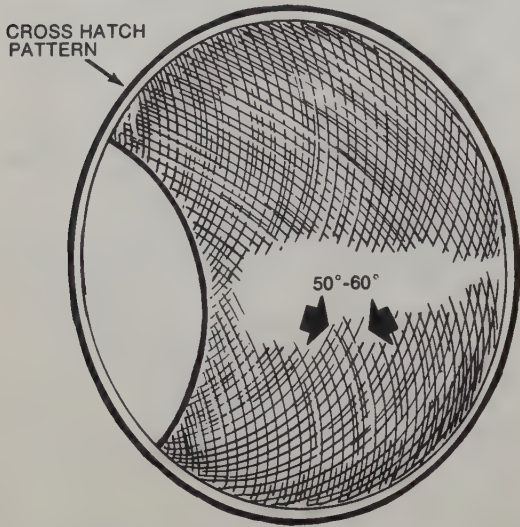
CAUTION: If piston pin must be pressed in, determine the proper method and use the proper tools; otherwise the piston will distort.

Install the lock rings; ensure that they seat properly. If the parts are not within specifications, determine the service method for the type of engine. In some cases, piston and pin are serviced as an assembly when either is defective. Others specify reaming the piston and connecting rods for an oversize pin. If the connecting rod bushing is worn, it may in many cases be replaced. Reaming the piston and replacing the rod bushing are machine shop operations.

Cylinder Block Reconditioning

Procedure	Method
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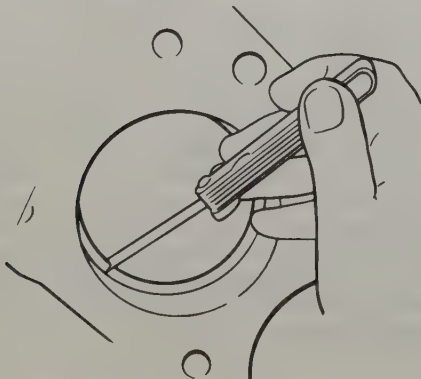
Finish hone the cylinders:



Chuck a flexible drive hone into a power drill, and insert it into the cylinder. Start the hone, and move it up and down in the cylinder at a rate which will produce approximately a 60° cross-hatch pattern.

NOTE: *Do not extend the hone below the cylinder bore.* After developing the pattern, remove the hone and recheck piston fit. Wash the cylinders with a detergent and water solution to remove abrasive dust, dry, and wipe several times with a rag soaked in engine oil.

Check piston ring end-gap:

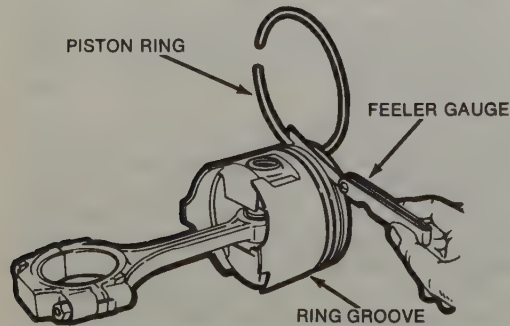


Compress the piston rings to be used in a cylinder, one at a time, into that cylinder, and press them approximately 1" below the deck with an inverted piston. Using feeler gauges, measure the ring end-gap, and compare to specifications. Pull the ring out of the cylinder and file the ends with a fine file to obtain proper clearance.

CAUTION: *If inadequate ring end-gap is utilized, ring breakage will result.*

Check the piston ring end gap

Install the piston rings:



Inspect the ring grooves in the piston for excessive wear or taper. If necessary, recut the groove(s) for use with an overwidth ring or a standard ring and spacer. If the groove is worn uniformly, overwidth rings, or standard rings and spacers may be installed without recutting. Roll the outside of the ring around the groove to check for burrs or deposits. If any are found, remove with a fine file. Hold the ring in the groove, and measure side clearance. If necessary, correct as indicated above.

NOTE: *Always install any additional spacers above the piston ring.*

Check the piston ring side clearance

The ring groove must be deep enough to allow the ring to seat below the lands (see illustration). In many cases, a "go-no-go" depth gauge will be provided with the piston rings. Shallow grooves may be corrected by recutting, while deep

Cylinder Block Reconditioning

Procedure

Method

Install the rear main seal:

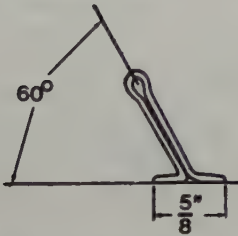
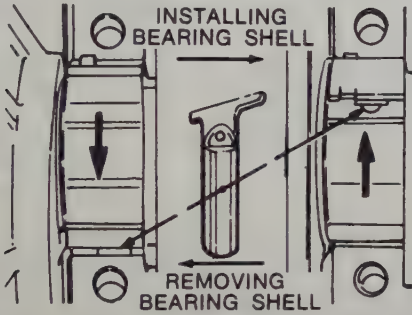
See the engine service procedures earlier in this chapter for details concerning specific engines.

Install the crankshaft:

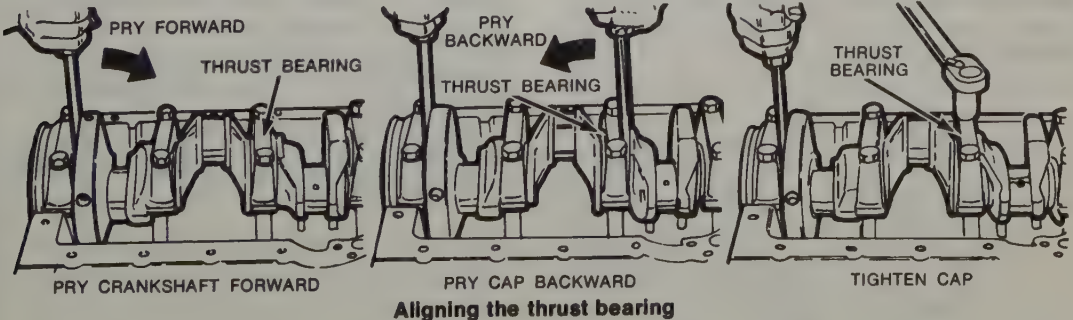
Thoroughly clean the main bearing saddles and caps. Place the upper halves of the bearing inserts on the saddles and press into position.

NOTE: *Ensure that the oil holes align.* Press the corresponding bearing inserts into the main bearing caps. Lubricate the upper main bearings, and lay the crankshaft in position. Place a strip of Plastigage on each of the crankshaft journals, install the main caps, and torque to specifications. Remove the main caps, and compare the Plastigage to the scale on the Plastigage envelope. If clearances are within tolerances, remove the Plastigage, turn the crankshaft 90°, wipe off all oil and retest. If all clearances are correct, remove all Plastigage, thoroughly lubricate the main caps and bearing journals, and install the main caps. If clearances are not within tolerance, the upper bearing inserts may be removed, without removing the crankshaft, using a bearing roll out pin (see illustration). Roll in a bearing that will provide proper clearance, and retest. Torque all main caps, excluding the thrust bearing cap, to specifications. Tighten the thrust bearing cap finger tight. To properly align the thrust bearing, pry the crankshaft the extent of its axial travel several times, the last movement held toward the front of the engine, and torque the thrust bearing cap to specifications. Determine the crankshaft end-play (see below), and bring within tolerance with thrust washers.

Remove or install the upper bearing insert using a roll-out pin



Home-made bearing roll-out pin



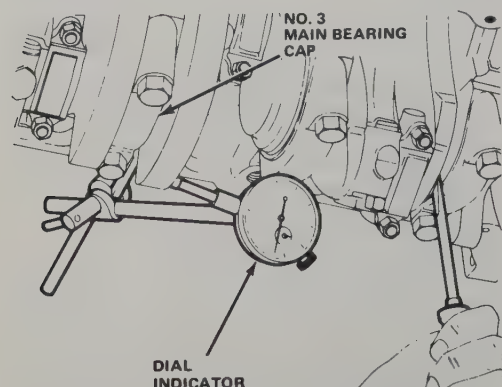
Aligning the thrust bearing

Measure crankshaft end-play:

Mount a dial indicator stand on the front of the block, with the dial indicator stem resting on the

Cylinder Block Reconditioning

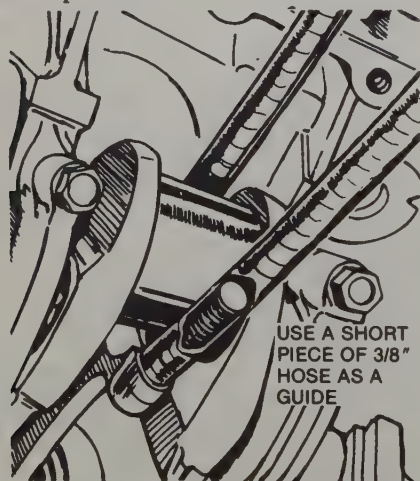
Procedure



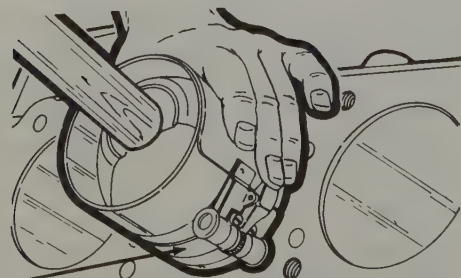
Check the crankshaft end-play with a dial indicator

Check the crankshaft end-play with a feeler gauge

Install the pistons:



Use lengths of vacuum hose or rubber tubing to protect the crankshaft journals and cylinder walls during piston installation

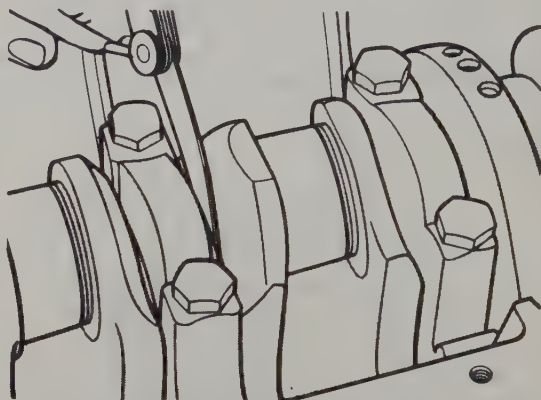


RING COMPRESSOR

Method

nose of the crankshaft, parallel to the crankshaft axis. Pry the crankshaft the extent of its travel rearward, and zero the indicator. Pry the crankshaft forward and record crankshaft end-play.

NOTE: Crankshaft end-play also may be measured at the thrust bearing, using feeler gauges (see illustration).



Press the upper connecting rod bearing halves into the connecting rods, and the lower halves into the connecting rod caps. Position the piston ring gaps according to specifications (see car section), and lubricate the pistons. Install a ring compressor on a piston, and press two long (8") pieces of plastic tubing over the rod bolts. Using the tubes as a guide, press the pistons into the bores and onto the crankshaft with a wooden hammer handle. After seating the rod on the crankshaft journal, remove the tubes and install the cap finger tight. Install the remaining pistons in the same manner. Invert the engine and check the bearing clearance at two points (90° apart) on each journal with Plastigage.

NOTE: Do not turn the crankshaft with Plastigage installed.

If clearance is within tolerances, remove all Plastigage, thoroughly lubricate the journals, and torque the rod caps to specifications. If clearance is not within specifications, install different thickness bearing inserts and recheck.

CAUTION: Never shim or file the connecting rods or caps.

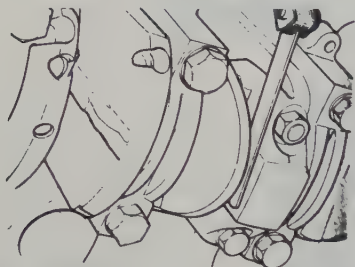
Always install plastic tube sleeves over the rod bolts when the caps are not installed, to protect the crankshaft journals.

Install the piston using a ring compressor

Cylinder Block Reconditioning

Procedure

Check connecting rod side clearance:



Check the connecting rod side clearance with a feeler gauge

Method

Determine the clearance between the sides of the connecting rods and the crankshaft using feeler gauges. If clearance is below the minimum tolerance, the rod may be machined to provide adequate clearance. If clearance is excessive, substitute an unworn rod, and recheck. If clearance is still outside specifications, the crankshaft must be welded and reground, or replaced.

Inspect the timing chain (or belt):

Visually inspect the timing chain for broken or loose links, and replace the chain if any are found. If the chain will flex sideways, it must be replaced. Install the timing chain as specified. Be sure the timing belt is not stretched, frayed or broken.

NOTE: *If the original timing chain is to be re-used, install it in its original position.*

See the engine service procedures earlier in this chapter for details concerning specific engines.

Completing the Rebuilding Process

Following the above procedures, complete the rebuilding process as follows:

Fill the oil pump with oil, to prevent cavitating (sucking air) on initial engine start up. Install the oil pump and the pickup tube on the engine. Coat the oil pan gasket as necessary, and install the gasket and the oil pan. Mount the flywheel and the crankshaft vibration damper or pulley on the crankshaft.

NOTE: *Always use new bolts when installing the flywheel.* Inspect the clutch shaft pilot bushing in the crankshaft. If the bushing is excessively worn, remove it with an expanding puller and a slide hammer, and tap a new bushing into place.

Position the engine, cylinder head side up. Install the cylinder head, and torque it as specified. Install the rocker arms and adjust the valves.

Install the intake and exhaust manifolds, the carburetor(s), the distributor and spark

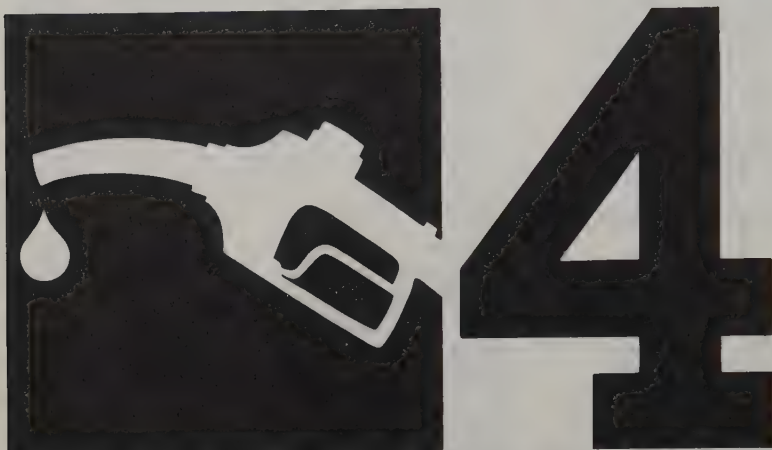
plugs. Adjust the point gap and the static ignition timing. Mount all accessories and install the engine in the car. Fill the radiator with coolant, and the crankcase with high quality engine oil.

Break-in Procedure

Start the engine, and allow it to run at low speed for a few minutes, while checking for leaks. Stop the engine, check the oil level, and fill as necessary. Restart the engine, and fill the cooling system to capacity. Check the point dwell angle and adjust the ignition timing and the valves. Run the engine at low to medium speed (800–2500 rpm) for approximately ½ hour, and retorquing the cylinder head bolts. Road test the car, and check again for leaks.

Follow the manufacturer's recommended engine break-in procedure and maintenance schedule for new engines.

Emission Controls and Fuel System



EMISSION CONTROLS

According to Federal law, motor vehicles must be equipped with pollution control devices which limit the quantities of harmful pollutants emitted into the atmosphere. Toyota has been successful in developing various emission control systems which minimize atmospheric pollution without seriously limiting the overall performance of the engines.

There are three major sources of vehicle emissions: exhaust gas, blow-by gases, and fuel evaporation. Exhaust gases contain unburned hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x). Blow-by gases are high-pressure exhaust gases which force their way past the piston rings and enter the crankcase. Evaporation of gasoline from the fuel tank and carburetor also allows unburned hydrocarbons to enter the atmosphere.

Toyota trucks are equipped with systems to control emissions from all these sources.

Positive Crankcase Ventilation System

A positive crankcase ventilation (PCV) system is used on all engines. Blow-by gases are routed from the crankcase to the carburetor

where they are combined with the air/fuel mixture and burned in the cylinders.

A valve is used to prevent the gases in the crankcase from being ignited in the event of a backfire. The quantity of blow-by gases is also regulated by the PCV valve which is spring-loaded and has a variable orifice. The valve is mounted on the valve cover of the engine and should be replaced every 24,000 miles, on 1970-78 trucks, and 30,000 miles on 1979 and later trucks.

REMOVAL AND INSTALLATION

To remove the valve simply disconnect the hose from the top of the valve and remove the valve from the rubber grommet in the valve cover.

TESTING

Check the PCV system hoses and connections to determine that there are no leaks, then tighten or replace as necessary.

To check the operation of the valve, remove it and blow through both of its ends. When blowing through the end which goes toward the intake manifold, very little air should pass through the valve. When blowing from the valve cover side, the air should pass freely.

If the valve does not perform in this manner, replace it with a new valve.

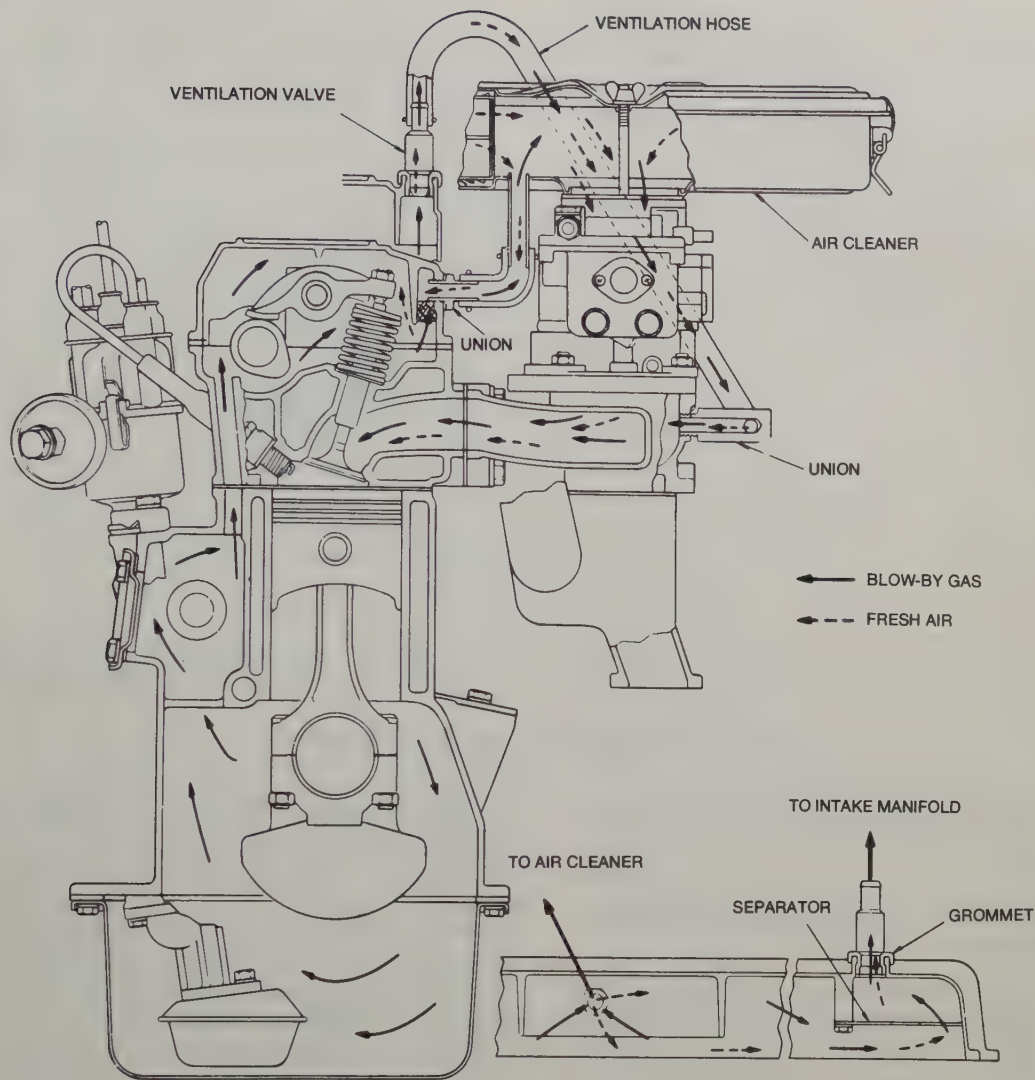
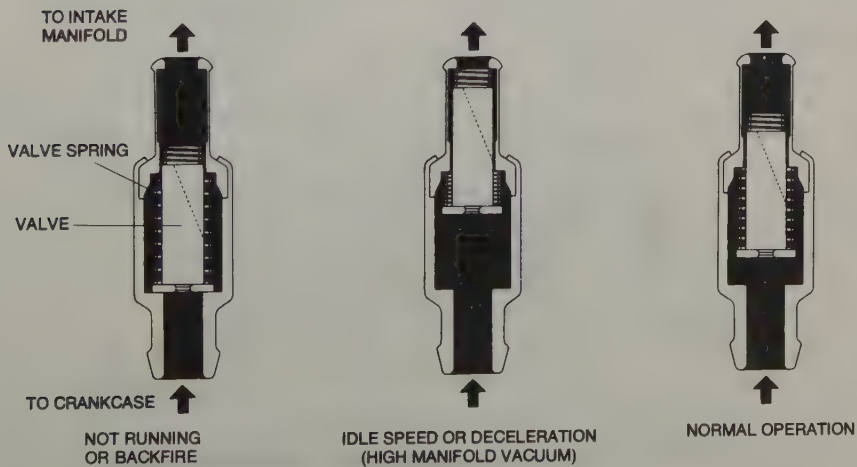
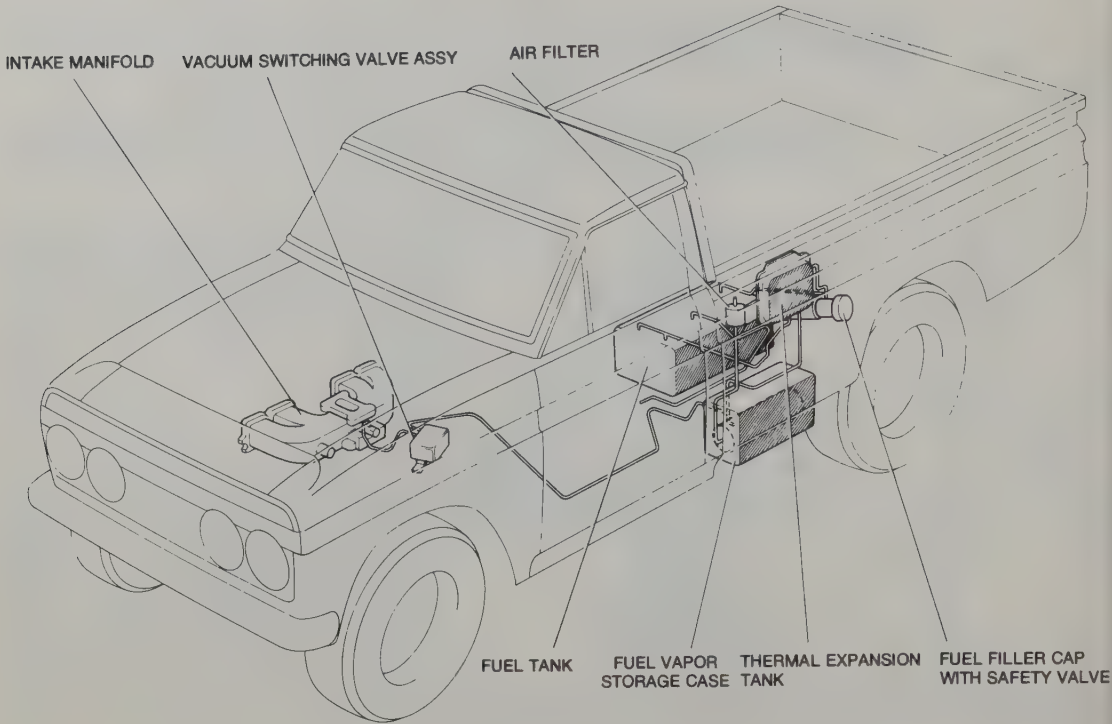


Diagram of the positive crankcase ventilation system—8R-C and 18R-C





The case storage system for evaporation control

NOTE: Toyota does not recommend cleaning of the PCV valve or any adjustments.

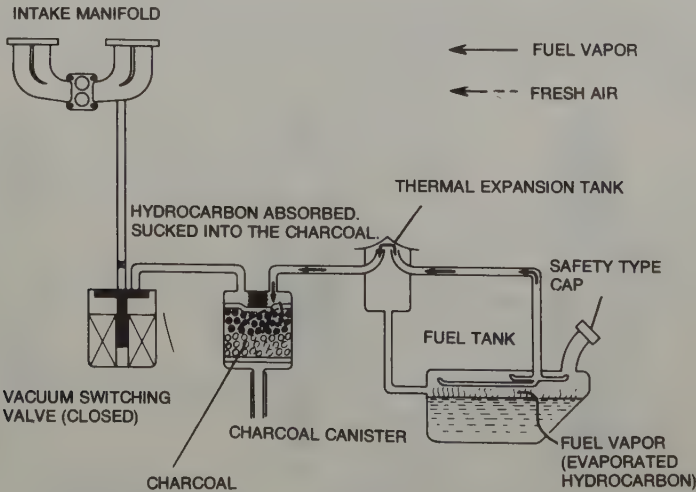
Evaporative Emission Control System

To prevent hydrocarbon emissions from entering the atmosphere due to the evaporation of fuel in the tank and carburetor, Toyota pick-up trucks are equipped with evaporative

emission control (EEC) systems. Between 1970 and 1971 the “case storage system” was used. Later models use the “charcoal canister” storage system.

The major components of the case storage system are a vacuum switching valve, a fuel vapor storage case, an air filter, a thermal expansion tank, and a special fuel tank.

When the vehicle is stopped or the engine is running at low speed, the vacuum switch-



Schematic of the charcoal canister vapor storage system

ing valve is closed; fuel vapor travels only as far as the case where it is stored. At cruising speed the vacuum switching valve opens and the stored vapors are drawn into the intake manifold along with fresh air drawn through the air filter.

The charcoal storage system functions in a similar manner with the exception that the vapors are stored in a canister filled with activated charcoal. The air filter is an integral part of the charcoal canister.

Required maintenance includes replacement of the air filter at regular intervals for the case storage system, and replacement of the charcoal canister at 50,000 mile intervals for the later system. Both maintenance procedures are covered in Chapter One.

NOTE: On 1979 and later models the charcoal canister should be checked at 30,000 and 60,000 miles. It is not necessary to replace the canister.

Throttle Positioner

During rapid deceleration large volumes of fuel/air mixture are drawn into the cylinders due to high manifold vacuum. If the throttle plates close completely there is not sufficient oxygen to permit complete combustion. Therefore a throttle positioner is installed to keep the throttle plates slightly open during deceleration. Vacuum is reduced under the throttle valve which, in turn, acts on the retard chamber of the distributor vacuum unit. This ignition retard compensates for the loss

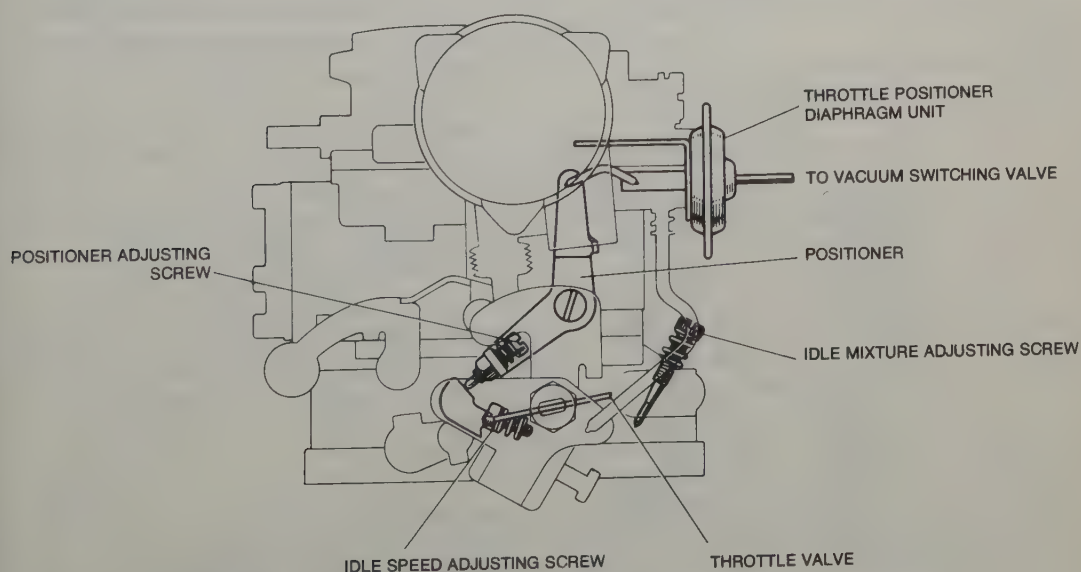
of engine braking caused by the partially-opened throttle.

NOTE: See the appropriate section in this chapter for a description of the dual diaphragm distributor.

Once the vehicle drops below a predetermined speed, the vacuum switching valve provides vacuum to the throttle positioner diaphragm. The throttle positioner then retracts allowing the throttle valve to close completely. The distributor also returns to normal operation.

ADJUSTMENT

1. Start the engine and allow it to reach normal operating temperature.
2. Adjust the engine idle speed as outlined in Chapter 2. Leave the tachometer connected.
3. Detach the vacuum line from the throttle positioner diaphragm and plug the line.
4. Accelerate the engine slightly to set the throttle positioner.
5. Check the engine speed with a tachometer when the positioner is in place.
6. The engine should run at 1,400 rpm (1,050 with automatic transmission and all 1978 and later trucks) with the positioner set. If it does not, adjust the throttle positioner adjusting screw.
7. Connect the vacuum hose to the positioner diaphragm.
8. The throttle lever should be freed from the positioner as soon as the vacuum line is



Components of the throttle positioner—8R-C engine. Other models similar

connected. Engine idle should return to normal.

9. If the throttle positioner fails to perform properly, check the linkage and diaphragm unit. If there are no defects in these components the problem probably lies in the vacuum switching valve or in the speed marker unit.

Dual Diaphragm Distributor

Some Toyota half-ton pick-ups with an 8R-C engine are equipped with a dual diaphragm distributor unit. This distributor has a retard diaphragm as well as an advance diaphragm.

Retarding the timing helps to reduce exhaust emissions as well as compensating for the lack of engine braking caused by the activation of the throttle positioner.

TESTING

NOTE: Check all vacuum hoses for leaks, kinks, or improper connections before making any tests, and install replacements where necessary.

1. Connect the timing light to the engine. Check the ignition timing as outlined in Chapter 2.

NOTE: Before proceeding with the test, disconnect any spark control devices, distributor vacuum valves, etc. If these are left connected, inaccurate results may be obtained.

2. Remove the retard hose from the distributor and plug it. As the engine speed increases, the timing should advance. If it does not, the vacuum unit is faulty and should be replaced.

3. Check the ignition timing with the engine running at idle speed. Connect the retard hose to the vacuum unit; the timing instantly should be retarded from 4–10 degrees. If this does not occur, the retard diaphragm has a leak and the vacuum unit must be replaced.

Transmission Controlled Spark (TCS) System

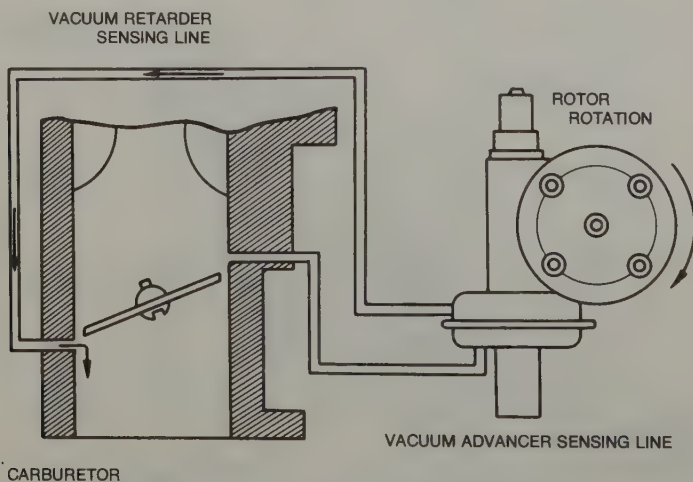
The TCS system alters the distributor advance curve under certain operating conditions, thereby reducing emissions of oxides of nitrogen (NO_x).

When the system is operational, the computer closes the vacuum switching valve (VSV) ground circuit. The valve in the VSV closes the passage between the distributor advance side and the carburetor advancer port. In this manner, advance of the engine timing is stopped.

The computer receives its messages from the speed sensor unit and the thermo sensor which only operates when the coolant temperature is between 140–210°F. 1975 and 1976 trucks use a TVSV (thermostatic vacuum switching valve) in addition to the VSV, computer, and speed sensor, to provide normal vacuum advance at engine temperatures below 122°F.

Spark Control (SC) System

A modified TCS system called Spark Control is used on 1977 and later trucks. The principle of delayed vacuum advance to minimize HC and NO_x emissions remains the same,



Dual diaphragm distributor—without the vacuum switching valve (VSV)

but the system is simplified by elimination of the computer control, VSV, and TVSV. Instead, a vacuum transmitting valve (VTV) is placed in the vacuum hose between the distributor diaphragm and the carburetor. Vacuum is delayed to the diaphragm by the closing of a check valve within the VTV. When intake vacuum drops (at wide throttle openings) the check valve opens and faster transmission of vacuum is allowed, thus advancing the distributor timing. The VTV is coded in a dark blue color in automatic transmission trucks, and brown in all manual transmission equipped trucks.

Exhaust Gas Recirculation System (EGR)

Oxides of nitrogen can only be formed under conditions of high pressure and high temperature. Elimination of one of these conditions reduces their production. A reduction of peak combustion temperature is accomplished by exhaust gas recirculation into the carburetor.

1974 California trucks, and all 1975 and later trucks are equipped with an EGR system. 1974 18R-C engines have a tube running from the exhaust manifold to the EGR valve, and a tube from the valve to the carburetor above the throttle plates. 1975–80 20R engines are similar, with the addition of an exhaust gas cooler cast into the rear of the cylinder head. 1974–76 systems use a thermo switch, computer, speed sensor, EGR valve, and a vacuum switching valve (VSV). In addition, 1974 18R-C engines have a temperature switch at the carburetor flange. When the speed sensor and thermo switch both are within their operating ranges, the computer turns the VSV on, which, in turn, opens the EGR valve, allowing a portion of the exhaust gases to re-enter the engine through the carburetor. 1977–78 EGR systems eliminate all but the EGR valve, and add a TVSV (thermostatic VSV). At coolant temperatures above 50°F, the TVSV opens allowing engine vacuum to open the EGR valve. This permits a recirculation of exhaust gases.

TESTING

1974–77

1. Check all vacuum hoses for breaks, kinks, and improper connections. Repair or replace as necessary.

2. After warming the engine to operating temperature, remove the air cleaner lid.

3. With the engine idling, connect the EGR valve and the intake manifold together with a length of vacuum hose. This should cause the carburetor to produce a bubbling noise. On the 1974 18R-C, disconnect the EGR valve sensing hose (marked with white tape) from the EGR valve. Disconnect the red hose from the VSV, and connect this to the EGR valve at the fitting normally connected to the white hose. Connected, the carburetor should produce a bubbling noise.

4. The noise should disappear when the vacuum hose is disconnected from the EGR valve.

If the carburetor fails to make the noise in Step 3, or if the noise does not stop when the hose is disconnected in Step 4, the EGR valve can be considered to be bad and should be replaced.

1978 and Later

1978 and later engines have a vacuum modulator attached to the EGR valve, a BVSV attached to the oil pan, and a VCV (except on those with automatic transmissions) in the vacuum hose between the carburetor and vacuum modulator. To test the system:

1. Check and clean the filter in the EGR vacuum modulator.

2. Disconnect the vacuum hose from the EGR port of the carburetor, and connect it to the intake manifold. The other end of this hose should remain attached to the BVSV.

3. Disconnect the vacuum hose from the EGR valve, and connect a vacuum gauge to the hose.

4. If your truck has a manual transmission, pinch off the vacuum hose between the VCV and the carburetor.

5. Start the engine and allow it to idle. The vacuum gauge reading should be zero at 2000 rpm if the engine is cold.

6. Allow the engine to warm up. The vacuum gauge should indicate a low vacuum at 2000 rpm. If it still reads zero, check the BVSV and modulator.

7. Release the pinched hose. The vacuum gauge should still indicate low vacuum at 2000 rpm. If not, check the VCV.

8. Pinch off the hose between the VCV and the carburetor. Disconnect the vacuum gauge. Remove the hose which runs from the BVSV to the front of the vacuum modulator, and connect it directly to the EGR valve, bypassing the modulator. The engine should

die. If so, the EGR valve is working properly. Reconnect the hoses and release the pinched hose.

EGR WARNING LIGHT (1975 ONLY)

1975 trucks have an EGR warning light on the instrument panel above the windshield wiper switch. This light is connected with the odometer in such a way that it lights every 25,000 miles. The light remains on until the switch is reset. The switch should not be reset until all required maintenance on the EGR and other emission systems has been performed. To reset the switch:

1. Remove the lock screw from the switch cover. This screw requires a tool with two prongs.
2. Remove the cover. Reset the switch by moving it to the position opposite from its current position.
3. Replace the cover and lock screw, and check to see that the light turns on when the ignition switch is turned to the Start position.

Air Injection (AI) System

The air injection system is used on all 20R trucks, 1975 and later.

Because of the many variables under which the engine operates, some hydrocarbon and carbon monoxide gases escape unburnt from the combustion chamber. To burn these gases more thoroughly, a belt-driven air pump is used to supply fresh air to an air injection manifold located just beyond the exhaust valves. The injection of fresh air causes more complete combustion of the hot unburned HC and CO gases. An air bypass valve (air switching valve in 1977 and later) is used to control the flow of air from the pump to prevent backfiring, which results from an overly rich mixture under closed throttle conditions.

A check valve prevents hot exhaust gas backflow into the pump and hoses, in case of a pump failure, or when the air bypass valve is not in operation. In trucks equipped with a catalytic converter, the air blown into the exhaust system is also used as the oxygen source for the oxidizing reaction. The system also includes an air switching valve (ASV). On trucks without catalytic converters, the ASV is used to stop air injection when the engine is in a constant heavy load condition. On engines with catalytic converters, the ASV is also used to prevent converter overheating, by diverting the injected air neces-

sary for converter operation. The air pump relief valve is built into the ASV.

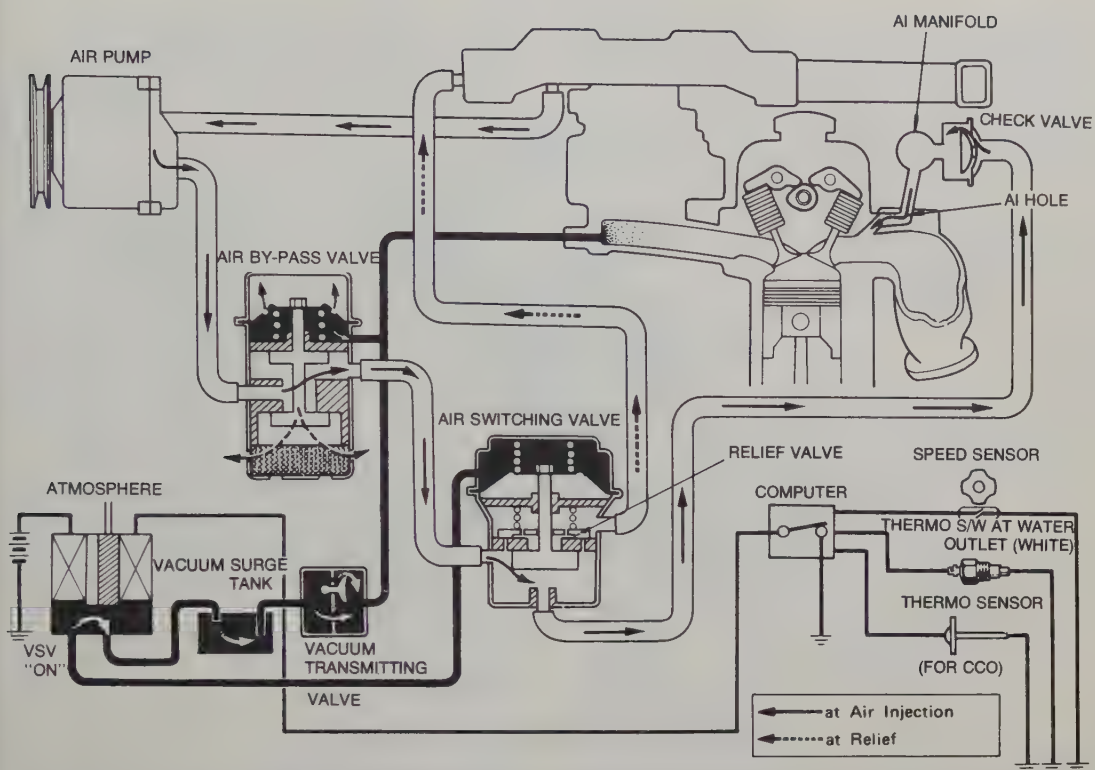
Other components of the 1975 and later system include a vacuum switching valve (VSV), a thermo switch, and a computer linked for input to the thermo switch and a speed sensor. The computer acts directly on the VSV. 1977-78 trucks eliminate the computer, speed sensor, thermo switch, and VSV, and add a vacuum control valve (VCV), and a thermostatic VSV (TVSV). High altitude trucks have two vacuum transmitting valves (VTV). One, coded yellow, is placed in the line between the ASV and the TVSV, and delays the closing of the ASV during hot engine/heavy load conditions. The other VTV, coded blue, delays the bypass of air for a few moments during high speed/hot temperature conditions, and is placed between the VCV and the carburetor.

MODES OF OPERATION

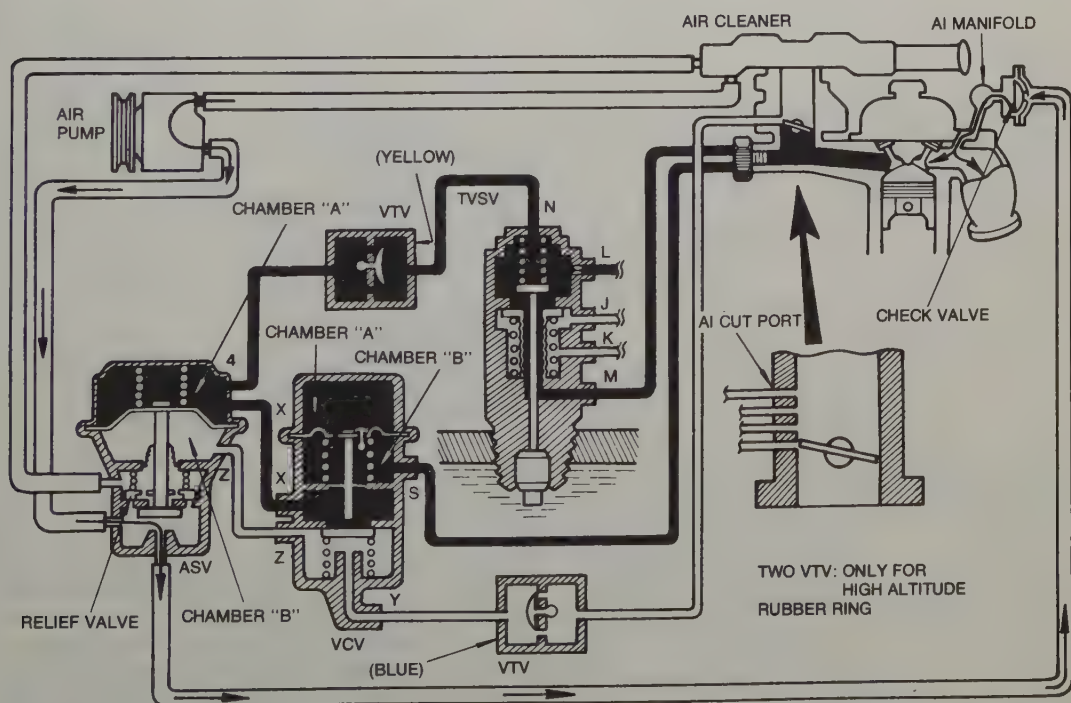
The air injection system normally operates in the hot engine/low speed mode outlined here. However, certain conditions cause the system to divert the air flow from the pump, to prevent problems such as backfiring, overheating, and poor cold engine performance. These conditions and the system operations are as follows:

Cold engine: During cold engine operation, air is diverted by the ASV to the air cleaner, rather than to the AI manifold. This is accomplished on 1975 and later trucks by the thermo switch, which signals the computer to turn off the VSV, which in turn causes the ASV to divert the air to the air cleaner. On 1977 and later trucks, the TVSV closes the vacuum passage between the ASV and the intake manifold. This closes the ASV, diverting the air to the air cleaner.

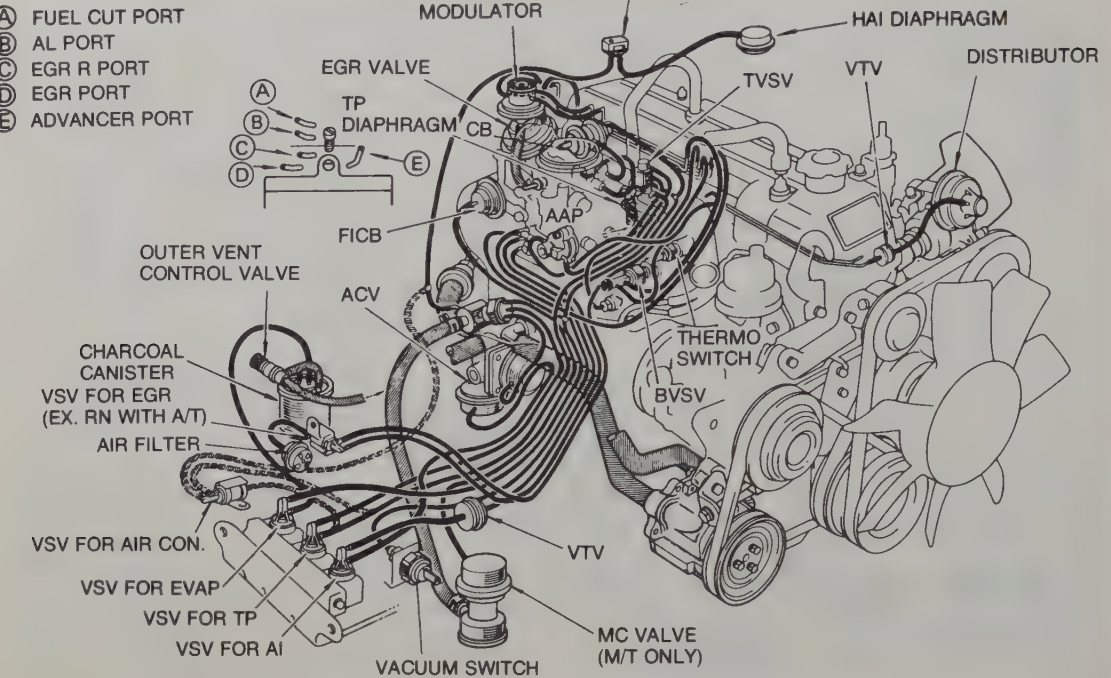
Hot engine/low speed: At engine temperatures above 55°F on 1975-76 trucks, the computer is signaled by the thermo switch and speed sensor to turn the VSV on, which causes the intake manifold vacuum to open the ASV, which in turn then allows air to flow from the pump to the AI manifold, where it ignites the hot HC and CO gases. This is the normal operating mode for the AI system. On 1977 and later trucks, the TVSV opens the vacuum passage between the intake manifold and the ASV, with the same result as in the earlier system. In both cases, if the air pump pressure rises above a predetermined level, the ASV relief valve opens, venting that air through the VCV to the air cleaner.



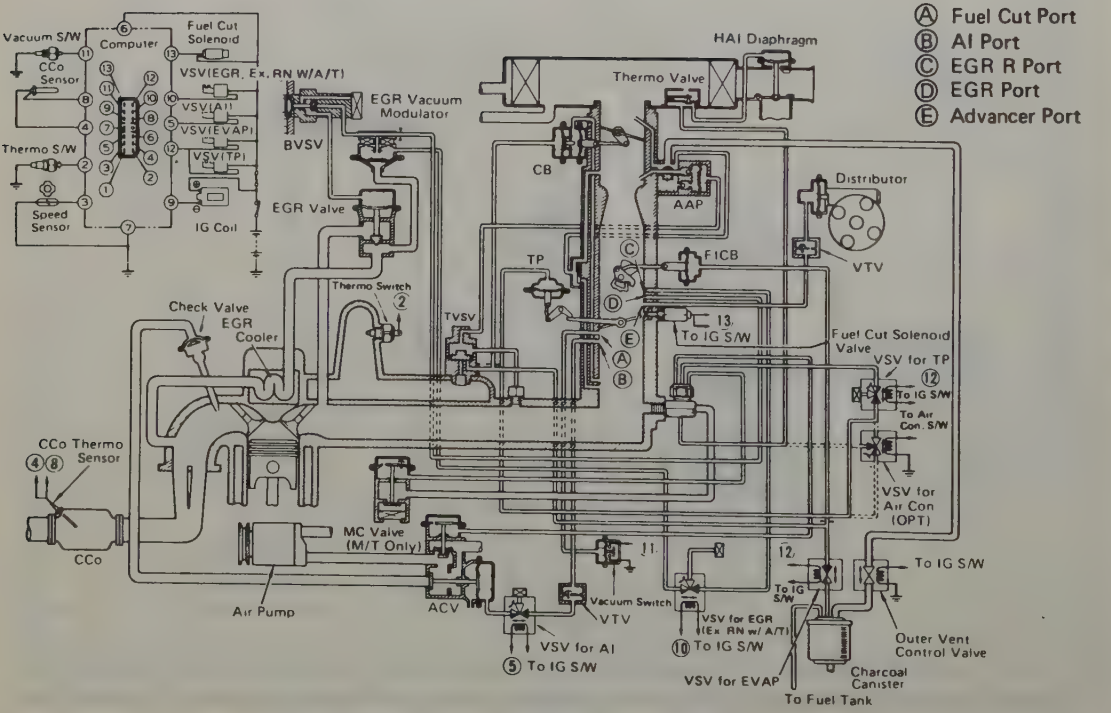
Components of the Air Injection system 1975-1976. This illustration shows the path of air from the pump both when injected and when diverted



Components of the 1977 and later Air Injection system, shown here in the hot engine-low speed mode



Emission control components 1979 and later



Emission control schematic 1979 and later

Hot engine/high speed: The speed sensor in 1975 and later trucks causes the computer to turn the VSV off, which in turn causes the ASV to divert the pumped air to the air cleaner. On later trucks, the vacuum from the AI port in the carburetor acts on the ASV bottom chamber, while intake manifold vacuum acts on the ASV top chamber. This results in an equal vacuum on both sides of the ASV diaphragm. The equilibrium is overcome by a spring on the diaphragm located in the upper chamber, which closes the ASV, diverting the pumped air to the air cleaner. On high altitude trucks, this action is delayed by the blue VTV.

Hot engine/sudden deceleration: The sudden increase of vacuum from the intake manifold, caused by the closed throttle, opens the air bypass valve, which vents the pumped air to the atmosphere on 1975-76 trucks. On 1977 and later models, the sudden closing of the throttle and subsequent loss of vacuum from the carburetor to the VCV allows the ASV to close, diverting the air to the air cleaner.

Hot engine/heavy load: On all trucks, the decrease in intake manifold vacuum causes the ASV to close, diverting the air to the air cleaner. On 1977 and latter high altitude trucks, this action is delayed by the yellow VTV.

Catalytic Converter (CCO) System

Catalytic converters are used on 1976 and latter trucks sold in California, and 1977 and latter trucks sold in high altitude areas. The converter is a muffler-shaped device, located in the exhaust system between the manifold and the muffler. Its purpose is to oxidize hydrocarbons (HC) and carbon monoxide (CO).

The catalyst is made of noble metals (platinum and palladium) bonded to pellets of granular alumina. These catalysts cause the HC and CO to break down into water and carbon dioxide (CO₂) without taking part in the reaction; thus, it is reasonable to expect a catalyst life of 50,000 miles in normal use. The air pump used in the air injection system also supplies fresh air to the catalyst via the exhaust pipe; this fresh air is used to supply oxygen for the reaction. A thermosensor, inserted into the body of the converter, shuts off the air supply if catalyst temperatures become excessive.

The same sensor circuit also causes an in-

strument panel warning light labeled "EXH TEMP" to come on when the temperature rises beyond the predetermined level.

NOTE: It is normal for the light to come on temporarily if the truck is driven downhill for long periods of time (such as when descending a mountain).

The light will come on and stay on if the air injection system is malfunctioning or if the engine is misfiring, both of which will cause the catalyst temperature to rise.

PRECAUTIONS

1. Use only unleaded fuel.
2. Avoid prolonged idling; the engine should run no longer than 20 minutes at curb idle, nor longer than 10 minutes at fast idle.
3. Reduce fast idle speed, by quickly depressing and releasing the accelerator pedal, as soon as the coolant temperature reaches 120°F.
4. Do not disconnect any spark plug leads while the engine is running.
5. Make engine compression checks as quickly as possible.
6. Do not dispose of the catalyst in a place where anything coated with grease, gas, or oil is present.

CATALYST TESTING

At the present time there is no known way to reliably test catalytic converter operation in the field. The only reliable test is a 12 hour and 40 minute "soak test" (CVS) which must be done in a laboratory.

An infrared HC/CO tester is not sensitive enough to measure the higher tailpipe emissions from a partially-failed converter. Thus, a bad converter may allow enough HC and CO emissions to escape, so that the truck is not in compliance with Federal (or state) standards, but still will not cause the needle on the HC/CO tester to move off zero.

A *completely* failed converter should cause the tester to show a slight reading. As a result, it should be possible to spot one of these.

As long as you avoid severe overheating or use of leaded fuels and the truck has less than 50,000 miles on it, it is safe to assume that the converter is working.

If you are in doubt about the converter, take your truck to the diagnostic center which has an infrared tester.

WARNING LIGHT CHECKS

NOTE: The warning light will come on when the ignition switch is turned to the

Start position, as a means of checking its operation.

1. If the warning light illuminates and remains on, check the components of the air injection system. If these are not defective, check the ignition system for faulty leads, plugs, points, or igniter.

2. If no problems can be found in Step 1, check the warning light wiring for short or open circuits.

3. If nothing can be found in Steps 1 or 2, check the operation of the emission control system vacuum switching valve or the computer, either by substitution of a new unit, or by taking the truck to a service facility which has Toyota's diagnostic emission control system checker.

CONVERTER REMOVAL AND INSTALLATION

CAUTION: Do not perform this operation on a hot (or even warm) engine. Catalyst temperatures may go as high as 1,700°F, so that any contact with the catalyst could cause severe burns.

1. Disconnect the lead from the converter thermosensor.

2. Remove the wiring shield.

3. Unfasten the pipe clamp securing bolts at either end of the converter. Remove the clamps.

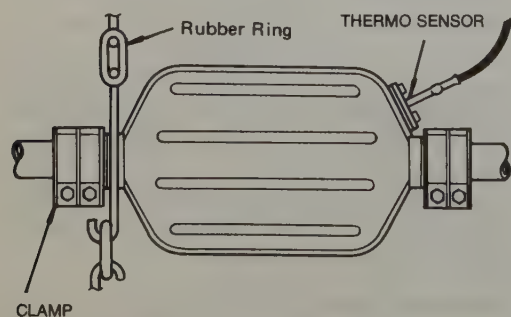
4. Push the tailpipe rearward and remove the converter, complete with thermosensor.

5. Carry the converter with the thermosensor upward to prevent the catalyst from falling out.

6. Unfasten the screws and take out the thermosensor and gasket.

Installation is as follows:

1. Place a new gasket on the thermosensor. Push the thermosensor into the converter and secure it with its two bolts. Be careful not to drop the thermosensor.



Typical catalytic converter installation

NOTE: Service replacement converters are provided with a plastic thermosensor guide. Slide the sensor into the guide to install it. Do not remove the guide.

2. Install new gaskets on the converter mounting flanges.

3. Secure the converter with its mounting clamps.

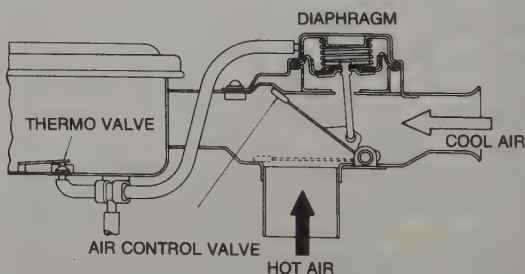
4. If the converter is attached to the body with rubber O-rings, install the O-rings over the body and converter mounting hooks.

5. Install the wire protector and connect the lead to the thermosensor.

Automatic Hot Air Intake (HAI)

All 1975 and later trucks are equipped with the HAI system, which consists of a heat stove around the exhaust manifold, a thermostatically controlled door (air control valve) in the air cleaner horn, and a length of insulated flexible pipe connecting the two. The purpose of the system is to keep the temperature of the air drawn into the carburetor as constant as possible. It directs a hot air supply to the carburetor in cold weather to provide faster engine warming and to reduce the possibility of carburetor icing. By providing the cold engine with warmer air, the choke stays on for a shorter length of time, thus reducing fuel consumption and the rich mixture condition. Leaner combustion mixtures are inherently lower in HC and CO emissions.

The air control valve in the air cleaner horn is controlled by a vacuum diaphragm. The vacuum hose is connected at one end to the diaphragm, and to both a thermo valve and intake manifold at the other. Initially, when cold, the thermo valve is closed. Intake manifold vacuum therefore causes the diaphragm to rise, opening the door in the air horn to admit preheated air drawn from the heat stove around the exhaust manifold. As the engine temperature rises, the thermo



20R HAI system—later models have a slightly different thermo valve

valve opens, thus reducing the intake manifold vacuum, allowing the diaphragm to lower, which in turn closes the door in the air horn to admit cool outside air.

INSPECTION

With the engine idling and warm, connect the diaphragm hose directly to the intake manifold, and plug the thermo valve hose end. The air control valve should rise to admit hot air.

As with all vacuum-operated systems, the hoses should be checked for any kinks, breaks, or improper connections. If none are found and the air valve does not work properly, the diaphragm and the thermo valve must be checked. Suction applied to the vacuum hose should cause the diaphragm to raise the door. If it does, the thermo valve can be considered faulty. If not, the diaphragm should be replaced.

Auxiliary Acceleration Pump (AAP) System

To reduce emissions, carburetor air/fuel mixtures are calibrated to be as lean as possible. Although a lean mixture will burn readily at hotter temperatures, it is reluctant to ignite when cold—not because of the mixture as such, but because fuel vaporizes less readily when cold. Thus, increasing the amount of fuel in a cold air/fuel mixture increases the amount of vaporized fuel available.

The problem of a poor air/vaporized fuel mixture in a cold engine is accentuated when accelerating. Although the carburetor is equipped with an acceleration pump for normal accelerating engine demands, its capacity is insufficient for a cold engine. The aux-

iliary acceleration pump (AAP) is designed to send additional fuel into the acceleration nozzle in the carburetor independent of the regular acceleration pump. All 1975 and later trucks are equipped with the AAP system.

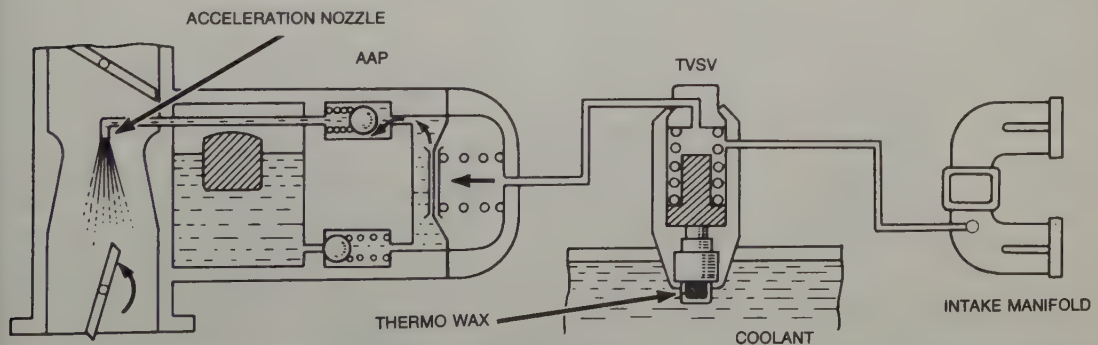
The AAP itself is an integral part of the carburetor. It consists of two check valves controlled by springs, and a diaphragm controlled by both a spring and engine vacuum obtained from the intake manifold. At constant speeds, intake manifold vacuum draws the AAP diaphragm back, enlarging the AAP chamber and thus allowing gasoline to enter. When the engine is accelerated, intake manifold vacuum drops, allowing the AAP diaphragm to be pushed back by the spring. The resultant reduction in chamber volume forces the gasoline out through the other check valve, into the acceleration nozzle. Thus, the engine gets a needed squirt of gasoline.

AAP operation is governed by the same TVSV described in the AI section earlier. At cold coolant temperatures, the TVSV allows intake manifold vacuum to reach the AAP diaphragm. At approximately 122°F, the TVSV closes off the passage to vacuum, thus shutting off the AAP.

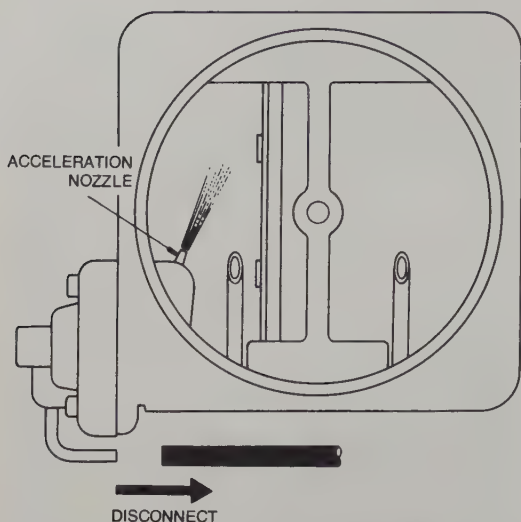
INSPECTION

The vacuum hose should be checked for leaks, kinks, or improper connections.

1. With the engine cold (below 75°F) and idling (front wheels blocked, parking brake on, transmission in neutral) remove the air cleaner cap and look into the carburetor. At the instant the vacuum hose is removed from the AAP, gasoline should squirt from the nozzle.



In this cross section view of the AAP system, the intake manifold vacuum has dropped enough to allow the AAP diaphragm to move in the direction of the arrow, forcing gasoline past the upper check valve into the acceleration nozzle



To test the AAP, disconnect the vacuum hose while looking into the carburetor for a squirt of gas from the acceleration nozzle

2. If it does not, check for vacuum in the hose. If present, the AAP diaphragm may be defective, the nozzle may be blocked, the check valves may be stuck, or gasoline may not be flowing into the chamber.

3. If there is no vacuum in the line, either the line has an air leak or the TVSV is defective.

4. After warming the engine to operating temperature, perform the same test as in Step 1. If gasoline spurts out, the TVSV is defective.

Choke Breaker (CB) System

All 20R and 22R engines use an automatic choke, consisting of a thermostatic bimetal spring which expands and contracts in response to cold and heat. This spring is con-

nected by mechanical linkage to the choke plate, and heated by the engine coolant. When the engine is cold, the spring expands and closes the choke. As the engine heats, the spring contracts opening the choke.

1975, and 1977 and later engines have a Choke Breaker (CB) system (called Choke Opener in 1975) attached to the choke plate by mechanical linkage. The CB is essentially a diaphragm actuated by intake manifold vacuum. The vacuum causes the diaphragm to pull back on the linkage, opening the choke plate slightly against the force of the automatic choke spring.

The purpose of the CB system is to prevent the cold engine from receiving an over-rich mixture, caused by the closed choke plate, because rich mixtures are higher in HC and CO emissions.

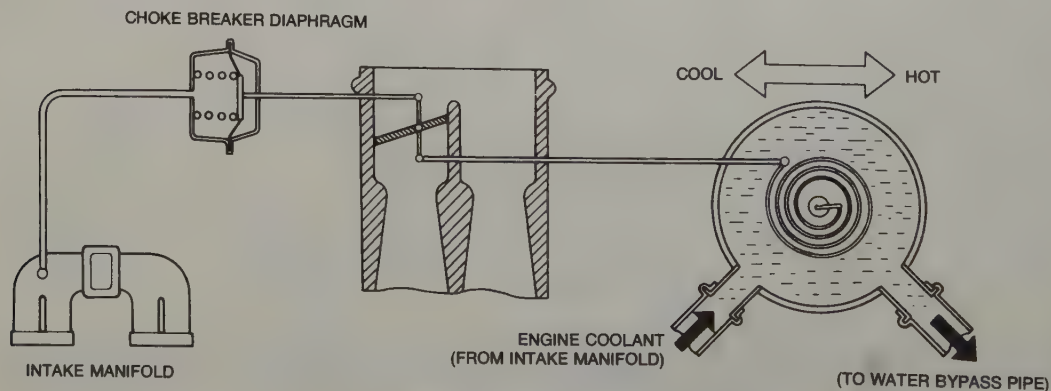
INSPECTION

Check the vacuum hose first for leaks, kinks, and improper connections.

1. With the engine cold and idling (parking brake set, front wheels blocked, and transmission in neutral), remove the lid from the air cleaner. Disconnect the vacuum hose from the CB diaphragm, while watching to see if the link is pulled out of the diaphragm by the force of the automatic choke spring.

2. When the hose is reconnected, the diaphragm should pull the link back in toward itself.

If CB does not operate properly, either the linkage is binding or the diaphragm is faulty. The linkage should be cleaned thoroughly with a carburetor cleaning spray and a clean cloth, but it should not be lubricated with any substance whatsoever. If this does not restore proper CB operation, the diaphragm should be replaced.



20R Choke Breaker and automatic choke systems

Fast Idle Cam Breaker (FICB)

After warm-up this system forcibly releases the fast idle cam which lowers the engine speed.

1. Connect the vacuum gauge between the fast idle cam breaker and the three way connector using enough hose to allow the gauge to rest on the truck fender.

2. Jack up the front and rear of the truck and support it with jack stands.

3. Start the engine, and with the coolant temperature below 122°F check that the vacuum is zero regardless of the driving speed.

NOTE: Do not run the truck at high speeds while supported by the jack stands.

4. Run the engine to normal temperature.

5. Check that the vacuum is high at 7 mph.

6. Check that the vacuum is lower (than the step 4 reading) above 16 mph. If a problem is found inspect the speed sensor, VSV, and the TVSV.

7. Check the diaphragm and linkage operation.

8. Disconnect the vacuum gauge and reconnect the hose to the proper location.

9. Stop the engine.

10. Remove the hose from the fast idle cam breaker.

11. Set the idle cam. While holding the throttle valve slightly open, pull up on the fast idle cam linkage and release the throttle.

12. Start the engine but do not touch the accelerator.

13. Reconnect the hose and check that the fast idle cam is released and the engine returns to idle.

If a problem is found check the diaphragm, linkage hoses, and the TVSV. Apply vacuum to the FICB diaphragm and check that the linkage moves, if not replace the diaphragm.

Deceleration Fuel Cut System

CALIFORNIA ONLY

This system cuts off part of the fuel in the slow circuit of the carburetor to prevent overheating and afterburning of the exhaust system.

1. Connect a tachometer to the engine.
2. Start the engine and check that it runs normally.

3. Pinch the vacuum hose to the vacuum switch.

4. Gradually increase the engine speed to

3000 rpm. Check that the engine misfires slightly between 2400 and 3000 rpm.

CAUTION: Perform this procedure quickly to avoid overheating the catalytic converter.

5. Release the hose and gradually increase the engine speed to 3000 rpm. Check that the engine operation is normal.

6. With the engine at idle unplug the solenoid valve. Check that the engine misfires or stalls.

7. If a problem is found check the switch and solenoid. If everything is normal connect the vacuum line and wiring.

Fuel Cut Solenoid Valve and Vacuum Switch

1. Remove the solenoid.

2. Test that the solenoid is operating properly. This can be done by connecting two wires to the battery terminals, one negative, one positive. By attaching these wires to the switch you will hear it click. The click indicates it is operating properly.

3. Check the O-ring for damage.

4. Reinstall the solenoid, if no problem is found.

5. Use an ohmmeter to check that there is continuity between the switch terminal and the body.

6. Start the engine.

7. Check now for no continuity between the switch terminal and the body.

Secondary Slow Circuit Fuel Cut System

This system cuts off part of the fuel in the secondary slow circuit of the carburetor to prevent dieseling.

INSPECTION OF THE FUEL CUT VALVE

1. Fully open and close the throttle valve.

2. Measure the stroke. It should be 0.059 in.-0.079 in.

3. If adjustment is necessary bend the lever.

NOTE: The stroke should be set to the above specifications before the secondary throttle valve opens. (Before kick up).

High Altitude Compensation (HAC)

At high altitudes, air/fuel mixtures become richer, due to the thinner air available. The

High Altitude Compensation (HAC) system installed on 1977 and later trucks sold in federally-designated areas insures a proper air/fuel mix by supplying additional air to the low and/or high speed circuits at high altitude (above 4000 feet) to minimize HC and CO emissions. The system also advances the ignition timing to improve driveability at high altitudes.

The HAC system consists of an HAC valve, a dual diaphragm distributor, and a check valve.

HIGH ALTITUDE OPERATION

Low atmospheric pressure allows the bellows in the HAC valve to expand and close port "A". Intake manifold vacuum acts on the diaphragm in the HAC valve through the check valve, opening the passages between the carburetor and the atmosphere via the HAC valve. These open passages allow air to flow into the low and/or high speed circuits in the carburetor. As a result, the air/fuel mixture becomes leaner.

The intake manifold vacuum also acts on the sub-diaphragm in the distributor. This vacuum is maintained by the check valve, except in the following instance: a vacuum in the main diaphragm of the distributor rises

above 5.0 in. of mercury (Hg), the vacuum advance will revert to normal.

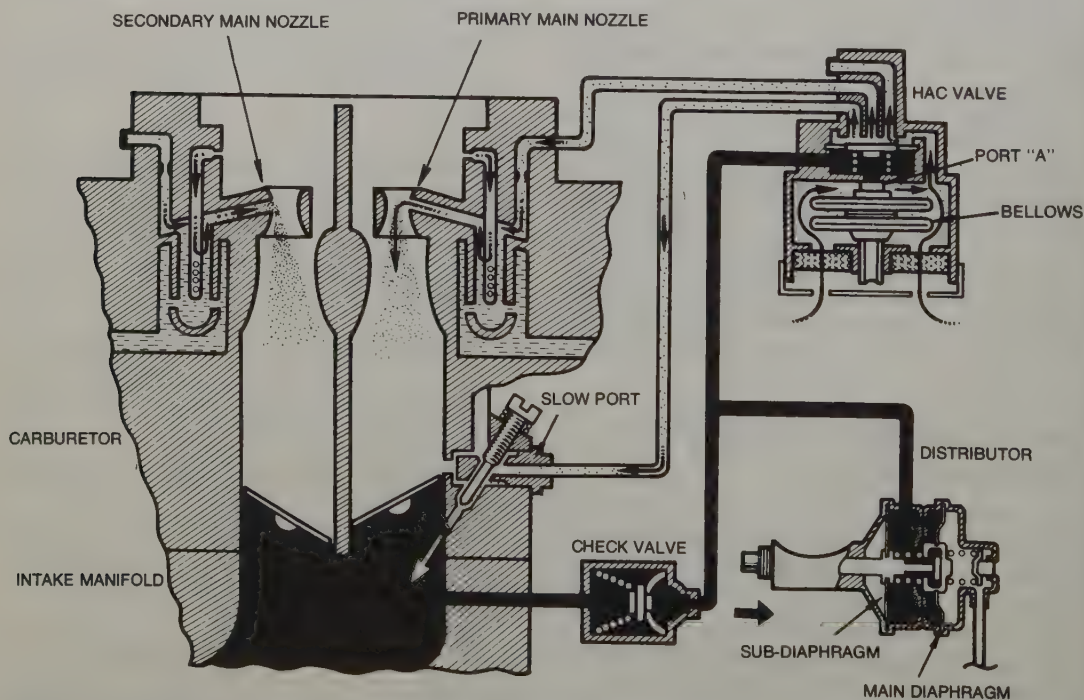
LOW ALTITUDE OPERATION

High atmospheric pressure, entering through the bottom of the HAC valve acts on the bellows and opens port "A". Since the intake manifold vacuum does not act on the diaphragm in the HAC valve, the air passage from the carburetor to the atmosphere is closed by the diaphragm. This prevents a lean mixture at lower altitudes.

The intake manifold vacuum also cannot act on the distributor sub-diaphragm, so the distributor advance is normal.

INSPECTION

NOTE: Before checking the HAC system at altitudes near 4000 feet, determine the position of the HAC valve. This can be done by blowing into any one of the three ports on top of the HAC valve when the engine is idling. If the passage is open, the valve is in the high altitude position. If it is closed, the valve is in the low altitude position. When the position is determined, proceed with the appropriate high altitude or low altitude inspection.



Operation of the HAC system at high altitudes. The check valve is shown here in the closed position, but as the carburetor throttle plates are opened, the check valve will also open due to higher intake manifold vacuum.

INSPECTION AT HIGH ALTITUDE

1. Check all vacuum hoses for leaks, breaks, kinks, or improper connections.
2. Visually inspect the HAC filter and replace it if clogged. It is located at the bottom of the HAC valve.
3. Start the engine and check the ignition timing as outlined in Chapter Two. If it is about 13° BTC, go on with the procedure. If it is only slightly out of adjustment, adjust the timing. If the hose between the HAC valve and the three way connector is pinched, does the ignition timing become about 13° BTC? If so, the HAC valve should be replaced. If not, the check valve must be inspected. It should be possible to blow air through it from the HAC side, and not from the intake manifold side. If faulty, replace. If not, the distributor vacuum advance is faulty and must be repaired or replaced.
4. If the hose between the white side of the check valve and the three way connector is pinched, the ignition timing should stay at 13° BTC for a minute or more. If not, replace the HAC valve.
5. If the hose is disconnected from the black side of the check valve and the hose end blocked, the ignition timing should stay at 13° BTC for one minute or more. If not, replace the check valve.
6. Disconnect the two HAC hoses from the carburetor. If air is blown into each hose, it should flow into the HAC valve. If not, replace the HAC valve.
7. Reconnect the two hoses to the carburetor and disconnect the same hoses from the HAC valve. If air is blown into each hose, it should flow into the carburetor. If not, the carburetor air passages are blocked.
8. If the air does flow into the carburetor, reconnect the hoses. The HAC system is operating correctly.

INSPECTION AT LOW ALTITUDE

1. Check all hoses for leaks, breaks, kinks, and improper connections.
2. Inspect the HAC filter, located in the bottom of the HAC valve, and replace it if clogged.
3. Start the engine and disconnect the two HAC hoses from the carburetor.
4. If air is blown into each hose, it should not flow into the HAC valve. If it does, replace the valve.
5. Reconnect the two hoses. Check the ig-

nition timing according to the procedures outlined in Chapter Two. It should be:

- 8° BTC @ 800 rpm with manual transmission
- 8° BTC @ 850 rpm with automatic transmission

The transmission should be in Neutral. If the timing is correct, the HAC system is okay.

6. If the timing is incorrect, disconnect the vacuum hose from the distributor sub-diaphragm. If the timing does not change, adjust the ignition timing. If the timing changes, replace the HAC valve.

FUEL SYSTEM**Mechanical Fuel Pump**

All 1970-74 8R-C and 18R-C trucks are equipped with single-action mechanical fuel pumps. The pump is located on the right-side of the engine just in front of the oil filter.

TESTING

Disconnect the outlet line from the fuel pump and connect a pressure gauge. Fuel pump pressure should measure 2.8-4.3 psi at 2500 rpm. There is normally enough gasoline in the carburetor float bowl to perform this test.

Discharge rate of the pump should also be checked. The 8R-C pump should deliver over 800 cc of gasoline per minute; the 18R-C rate should be 1500 cc/minute.

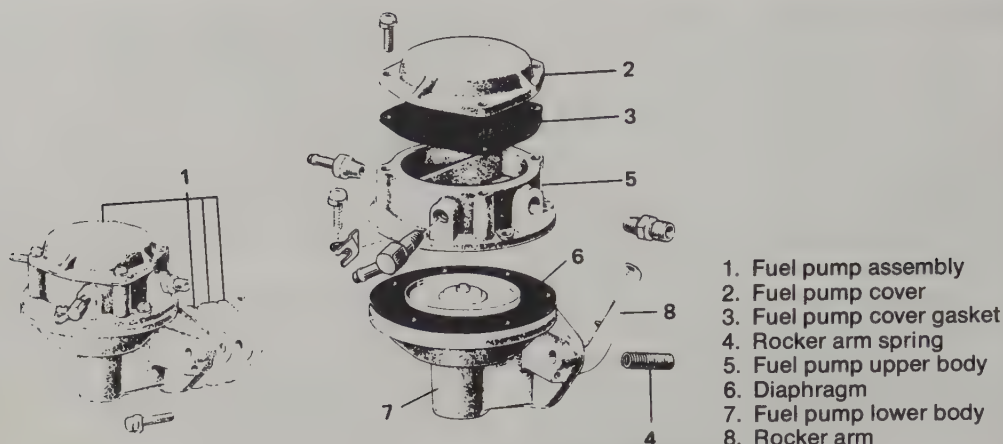
The fuel pump should not be replaced until both of those tests have been performed. If gasoline is not being delivered to the carburetor, the fuel filter, fuel tank, and all fuel lines should be checked for blockage. The carburetor float and needle should also be inspected for proper operation. These sources should be checked before replacing the fuel pump.

REMOVAL AND INSTALLATION

To remove the fuel pump simply disconnect and plug the fuel lines and remove the two bolts which hold the pump to the block.

When installing a new pump always use a new gasket between the pump and the block to prevent oil leakage. If any new rubber hose must be used to repair the fuel line, be sure that it is gasoline-resistant.

The 1979 and later engines are equipped with a mechanical type fuel pump. It is lo-



8R-C and 18R-C fuel pump disassembled

cated on the right hand side of the engine directly in front of the air cleaner.

1979 and later

1. Disconnect the negative battery terminal.

CAUTION: When working on the fuel system, do not smoke or work near any fire hazard. Keep gasoline off rubber or leather parts.

2. Drain the radiator.
3. Remove the upper radiator hose.
4. Remove all three lines from the fuel pump.

5. Remove the two bolts, the fuel pump, and gasket.

NOTE: The fuel pump is not repairable. It must be replaced as a complete unit.

6. Installation is the reverse of removal.

Electric Fuel Pump

All 20R engined trucks 1975-78 are equipped with an electric fuel pump, located in the gas tank. The pump is serviced as a unit; if it breaks, replace it.

TESTING

Before performing pressure and discharge rate tests, pump operation should be checked with the oil pressure switch disconnected. The reason for this is that the electric fuel pump is wired into the oil pressure warning light and pressure switch wiring, so that it operates only when the engine has sufficient oil pressure. (The fuel pump also runs when the ignition switch is turned to Start.)

To test the pump operation:

1. Disconnect the electrical clip from the oil pressure switch.

2. Turn the ignition switch to On.

3. Check for a smooth flow of gasoline from the fuel filter outlet. If the pump is noisy, it is probably defective. If the pump does not run, check the pump resistor and relay.

With the oil pressure switch electrical clip still off, check the discharge rate of the pump. Connect a line to the outlet of the fuel filter, turn the ignition switch to On, and measure the discharge capacity. It should be over 1.3 quarts per minute.

Turn the key off, and connect a pressure gauge to the filter outlet. Turn the ignition switch to On and measure to fuel pump pressure. It should be between 2.1 and 4.3 psi.

As with the mechanical pump, all tests should be performed, and all lines and the filter should be checked, before replacing the pump.

REMOVAL AND INSTALLATION

1. Remove the negative (-) cable from the battery.

2. Remove the fuel tank, after disconnecting the fuel lines. See Chapter 10 for fuel tank removal and installation.

3. Remove the bolts which secure the access plate to the tank. Remove the plate and its gasket, and remove the pump.

CAUTION: Do not operate the fuel pump unless it is immersed in gasoline and connected to its resistor.

Installation is the reverse of removal. Use a new gasket on the access plate, and check for leaks after installation.

FUEL PUMP RESISTOR

Check the resistor for continuity between the two terminals. If there is no continuity, re-

place the resistor and check the fuel pump operation.

Carburetor

Two barrel carburetors are used on all engines to provide an adequate air/fuel mixture under all operating conditions. The carburetors are equipped with an automatic choke, vacuum operated secondary barrels, a thermostatic valve to prevent over-rich mixtures in hot weather, and, on 18R-C and 20R engines, an electric solenoid valve for positive shut off of the fuel supply when the ignition is turned off.

OPERATION

All carburetors are similar in design having basic systems which enable them to perform their primary function of providing the correct air/fuel mixture for the engine.

These systems are float, starting, idle, progression, main feed, acceleration, and enrichment. Familiarity with these systems is helpful in the diagnosis and correction of carburetor malfunctions.

Float Circuit

The float mechanism maintains a constant fuel level so that atomization at all discharge jets will be uniform under varying conditions.

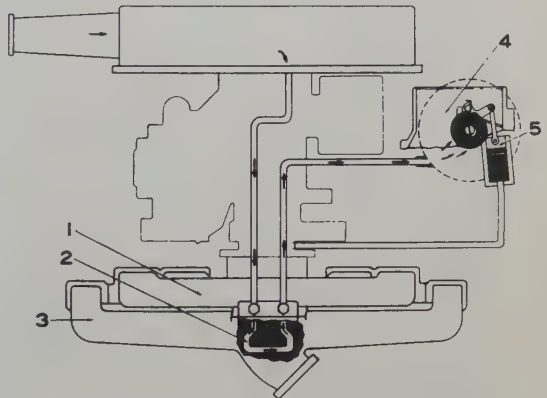
Operation of the system is simple. As the float drops, a needle valve is released which admits fuel from the fuel supply (pump). The rising fuel level in the float chamber lifts the float to its former level, closing the valve. Needle valves which are operated by the

float wear quickly and should be replaced in any major carburetor overhaul.

Starting Circuit

An automatic choke is used to increase the vacuum of a cranking engine. A choke consists of a plate which covers the throat of the carburetor. When this plate closes over the throat of the carburetor, blocking the airflow, a rich mixture of fuel and air is drawn into the jets to the carburetor throat.

The automatic choke mechanism of the 8R-C and 18R-C two-barrel carburetor operates via a thermostatic spring and a vacuum chamber. The thermostatic spring is set to fully close the choke valve at 77°F.



- | | |
|---------------------|------------------|
| 1. Intake manifold | 4. Coil housing |
| 2. Stove pipe | 5. Vacuum piston |
| 3. Exhaust manifold | |

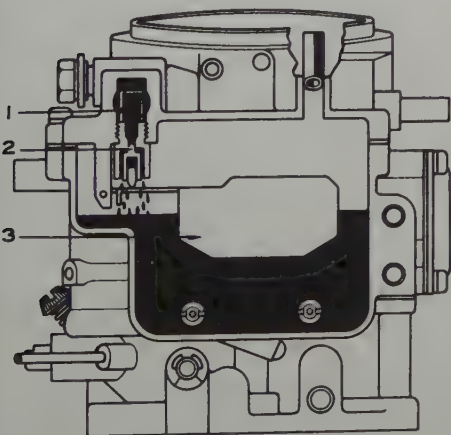
The automatic choke system—8R-C and 18R-C

As the engine is cranked vacuum in the intake manifold draws the vacuum piston down closing the choke valve. The pressure of the air being drawn through the carburetor causes the choke valve to open. As the engine warms, the bimetal spring releases the choke valve. Intake pressure and manifold vacuum balance each other causing the choke valve to remain open.

Operation of the 20R choke system is quite different from the earlier system, but the principle of an enriched mixture for cold engine operation remains the same. The 20R choke system is covered in the emission control section earlier in this chapter.

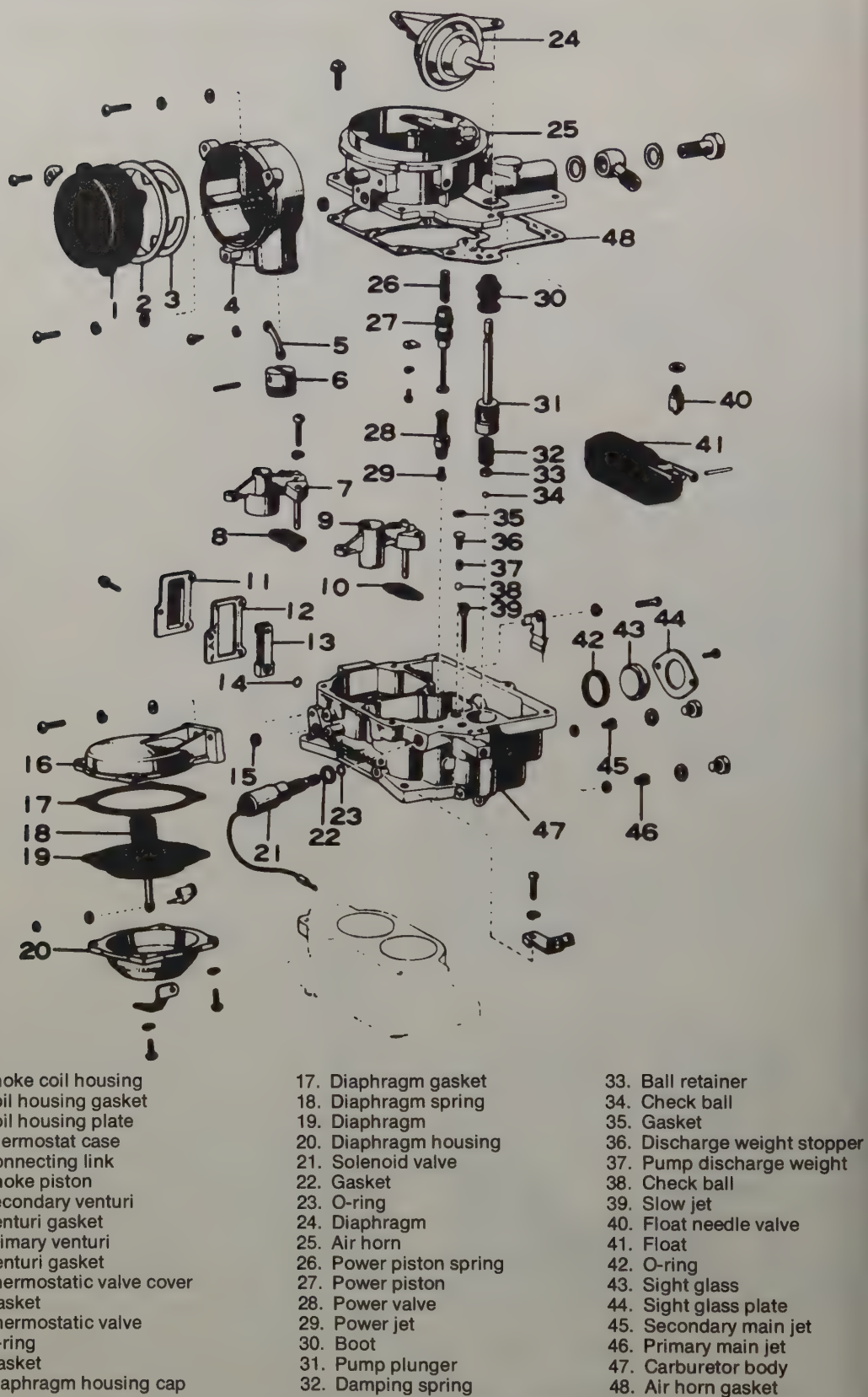
Idling Circuit

The idling system provides fuel for the engine when the throttle plate is closed or only slightly open. The system provides a rich mixture below the throttle plate by providing



- | | | |
|-------------|-----------------|----------|
| 1. Strainer | 2. Needle valve | 3. Float |
|-------------|-----------------|----------|

The float circuit



18R-C carburetor body components

55 WAYS
TO IMPROVE
FUEL ECONOMY

CHILTON'S FUEL ECONOMY & TUNE-UP TIPS

Tune-Up • Spark Plug Diagnosis • Emission Controls

Fuel System • Cooling System • Tires and Wheels

General Maintenance



CHILTON'S FUEL ECONOMY & TUNE-UP TIPS

Fuel economy is important to everyone, no matter what kind of vehicle you drive. The maintenance-minded motorist can save both money and fuel using these tips and the periodic maintenance and tune-up procedures in this Repair and Tune-Up Guide.

There are more than 130,000,000 cars and trucks registered for private use in the United States. Each travels an average of 10-12,000 miles per year, and, in total they consume close to 70 billion gallons of fuel each year. This represents nearly $\frac{2}{3}$ of the oil imported by the United States each year. The Federal government's goal is to reduce consumption 10% by 1985. A variety of methods are either already in use or under serious consideration, and they all affect your driving and the cars you will drive. In addition to "down-sizing", the auto industry is using or investigating the use of electronic fuel delivery,

electronic engine controls and alternative engines for use in smaller and lighter vehicles, among other alternatives to meet the federally mandated Corporate Average Fuel Economy (CAFE) of 27.5 mpg by 1985. The government, for its part, is considering rationing, mandatory driving curtailments and tax increases on motor vehicle fuel in an effort to reduce consumption. The government's goal of a 10% reduction could be realized — and further government regulation avoided — if every private vehicle could use just 1 less gallon of fuel per week.

How Much Can You Save?

Tests have proven that almost anyone can make at least a 10% reduction in fuel consumption through regular maintenance and tune-ups. When a major manufacturer of spark plugs sur-

TUNE-UP

1. Check the cylinder compression to be sure the engine will really benefit from a tune-up and that it is capable of producing good fuel economy. A tune-up will be wasted on an engine in poor mechanical condition.

2. Replace spark plugs regularly. New spark plugs alone can increase fuel economy 3%.

3. Be sure the spark plugs are the correct type (heat range) for your vehicle. See the Tune-Up Specifications.

Heat range refers to the spark plug's ability to conduct heat away from the firing end. It must conduct the heat away in an even pattern to avoid becoming a source of pre-ignition, yet it must also operate hot enough to burn off conductive deposits that could cause misfiring.

The heat range is usually indicated by a number on the spark plug, part of the manufacturer's designation for each individual spark plug. The numbers in bold-face indicate the heat range in each manufacturer's identification system.

Manufacturer	Typical Designation
AC	R 45 TS
Bosch (old)	WA 145 T30
Bosch (new)	HR 8 Y
Champion	RBL 15 Y
Fram/Autolite	415
Mopar	P- 62 PR
Motorcraft	BRF- 42
NGK	BP 5 ES- 15
Nippondenso	W 16 EP
Prestolite	14GR 5 2A



Periodically, check the spark plugs to be sure they are firing efficiently. They are excellent indicators of the internal condition of your engine.

On AC, Bosch (new), Champion, Fram/Autolite, Mopar, Motorcraft and Prestolite, a higher number indicates a hotter plug. On Bosch (old), NGK and Nippondenso, a higher number indicates a colder plug.

4. Make sure the spark plugs are properly gapped. See the Tune-Up Specifications in this book.

5. Be sure the spark plugs are firing efficiently. The illustrations on the next 2 pages show you how to "read" the firing end of the spark plug.

6. Check the ignition timing and set it to specifications. Tests show that almost all cars

veyed over 6,000 cars nationwide, they found that a tune-up, on cars that needed one, increased fuel economy over 11%. Replacing worn plugs alone, accounted for a 3% increase. The same test also revealed that 8 out of every 10 vehicles will have some maintenance deficiency that will directly affect fuel economy, emissions or performance. Most of this mileage-robbing neglect could be prevented with regular maintenance.

Modern engines require that all of the functioning systems operate properly for maximum efficiency. A malfunction anywhere wastes fuel. You can keep your vehicle running as efficiently and economically as possible, by being aware of your vehicles operating and performance characteristics. If your vehicle suddenly develops performance or fuel economy problems it could be due to one or more of the following:

PROBLEM	POSSIBLE CAUSE
Engine Idles Rough	Ignition timing, idle mixture, vacuum leak or something amiss in the emission control system.
Hesitates on Acceleration	Dirty carburetor or fuel filter, improper accelerator pump setting, ignition timing or fouled spark plugs.
Starts Hard or Fails to Start	Worn spark plugs, improperly set automatic choke, ice (or water) in fuel system.
Stalls Frequently	Automatic choke improperly adjusted and possible dirty air filter or fuel filter.
Performs Sluggishly	Worn spark plugs, dirty fuel or air filter, ignition timing or automatic choke out of adjustment.



Check spark plug wires on conventional point type ignition for cracks by bending them in a loop around your finger.



Be sure that spark plug wires leading to adjacent cylinders do not run too close together. (Photo courtesy Champion Spark Plug Co.)

- have incorrect ignition timing by more than 2°.
- 7. If your vehicle does not have electronic ignition, check the points, rotor and cap as specified.
 - 8. Check the spark plug wires (used with conventional point-type ignitions) for cracks and burned or broken insulation by bending them in a loop around your finger. Cracked wires decrease fuel efficiency by failing to deliver full voltage to the spark plugs. One misfiring spark plug can cost you as much as 2 mpg.
 - 9. Check the routing of the plug wires. Misfiring can be the result of spark plug leads to adjacent cylinders running parallel to each

- other and too close together. One wire tends to pick up voltage from the other causing it to fire "out of time".
- 10. Check all electrical and ignition circuits for voltage drop and resistance.
 - 11. Check the distributor mechanical and/or vacuum advance mechanisms for proper functioning. The vacuum advance can be checked by twisting the distributor plate in the opposite direction of rotation. It should spring back when released.
 - 12. Check and adjust the valve clearance on engines with mechanical lifters. The clearance should be slightly loose rather than too tight.

SPARK PLUG DIAGNOSIS

Normal

APPEARANCE: This plug is typical of one operating normally. The insulator nose varies from a light tan to grayish color with slight electrode wear. The presence of slight deposits is normal on used plugs and will have no adverse effect on engine performance. The spark plug heat range is correct for the engine and the engine is running normally.

CAUSE: Properly running engine.

RECOMMENDATION: Before reinstalling this plug, the electrodes should be cleaned and filed square. Set the gap to specifications. If the plug has been in service for more than 10-12,000 miles, the entire set should probably be replaced with a fresh set of the same heat range.



Incorrect Heat Range

APPEARANCE: The effects of high temperature on a spark plug are indicated by clean white, often blistered insulator. This can also be accompanied by excessive wear of the electrode, and the absence of deposits.

CAUSE: Check for the correct spark plug heat range. A plug which is too hot for the engine can result in overheating. A car operated mostly at high speeds can require a colder plug. Also check ignition timing, cooling system level, fuel mixture and leaking intake manifold.

RECOMMENDATION: If all ignition and engine adjustments are known to be correct, and no other malfunction exists, install spark plugs one heat range colder.

Oil Deposits

APPEARANCE: The firing end of the plug is covered with a wet, oily coating.

CAUSE: The problem is poor oil control. On high mileage engines, oil is leaking past the rings or valve guides into the combustion chamber. A common cause is also a plugged PCV valve, and a ruptured fuel pump diaphragm can also cause this condition. Oil fouled plugs such as these are often found in new or recently overhauled engines, before normal oil control is achieved, and can be cleaned and reinstalled.

RECOMMENDATION: A hotter spark plug may temporarily relieve the problem, but the engine is probably in need of work.



Carbon Deposits

APPEARANCE: Carbon fouling is easily identified by the presence of dry, soft, black, sooty deposits.

CAUSE: Changing the heat range can often lead to carbon fouling, as can prolonged slow, stop-and-start driving. If the heat range is correct, carbon fouling can be attributed to a rich fuel mixture, sticking choke, clogged air cleaner, worn breaker points, retarded timing or low compression. If only one or two plugs are carbon fouled, check for corroded or cracked wires on the affected plugs. Also look for cracks in the distributor cap between the towers of affected cylinders.

RECOMMENDATION: After the problem is corrected, these plugs can be cleaned and reinstalled if not worn severely.

MMT Fouled

APPEARANCE: Spark plugs fouled by MMT (Methycyclopentadienyl Manganese Tricarbonyl) have reddish, rusty appearance on the insulator and side electrode.

CAUSE: MMT is an anti-knock additive in gasoline used to replace lead. During the combustion process, the MMT leaves a reddish deposit on the insulator and side electrode.

RECOMMENDATION: No engine malfunction is indicated and the deposits will not affect plug performance any more than lead deposits (see Ash Deposits). MMT fouled plugs can be cleaned, regapped and reinstalled.



Ash (Lead) Deposits

APPEARANCE: Ash deposits are characterized by light brown or white colored deposits crusted on the side or center electrodes. In some cases it may give the plug a rusty appearance.

CAUSE: Ash deposits are normally derived from oil or fuel additives burned during normal combustion. Normally they are harmless, though excessive amounts can cause misfiring. If deposits are excessive in short mileage, the valve guides may be worn.

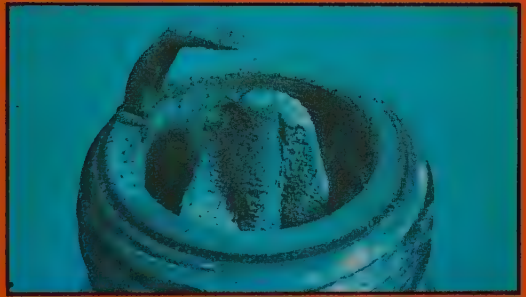
RECOMMENDATION: Ash-fouled plugs can be cleaned, gapped and reinstalled.

High Speed Glazing

APPEARANCE: Glazing appears as shiny coating on the plug, either yellow or tan in color.

CAUSE: During hard, fast acceleration, plug temperatures rise suddenly. Deposits from normal combustion have no chance to fluff-off; instead, they melt on the insulator forming an electrically conductive coating which causes misfiring.

RECOMMENDATION: Glazed plugs are not easily cleaned. They should be replaced with a fresh set of plugs of the correct heat range. If the condition recurs, using plugs with a heat range one step colder may cure the problem.



Detonation

APPEARANCE: Detonation is usually characterized by a broken plug insulator.

CAUSE: A portion of the fuel charge will begin to burn spontaneously, from the increased heat following ignition. The explosion that results applies extreme pressure to engine components, frequently damaging spark plugs and pistons.

Detonation can result by over-advanced ignition timing, inferior gasoline (low octane) lean air/fuel mixture, poor carburetion, engine lugging or an increase in compression ratio due to combustion chamber deposits or engine modification.

RECOMMENDATION: Replace the plugs after correcting the problem.

EMISSION CONTROLS

13. Be aware of the general condition of the emission control system. It contributes to reduced pollution and should be serviced regularly to maintain efficient engine operation.

14. Check all vacuum lines for dried, cracked

or brittle conditions. Something as simple as a leaking vacuum hose can cause poor performance and loss of economy.

15. Avoid tampering with the emission control system. Attempting to improve fuel econ-

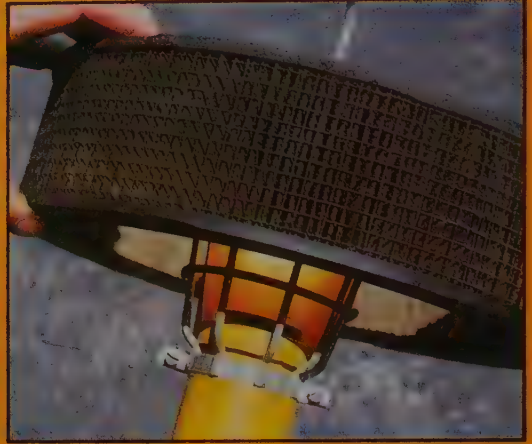
FUEL SYSTEM



Check the air filter with a light behind it. If you can see light through the filter it can be reused.

18. Replace the air filter regularly. A dirty air filter richens the air/fuel mixture and can increase fuel consumption as much as 10%. Tests show that 1/3 of all vehicles have air filters in need of replacement.

19. Replace the fuel filter at least as often as recommended.



Extremely clogged filters should be discarded and replaced with a new one.

20. Set the idle speed and carburetor mixture to specifications.

21. Check the automatic choke. A sticking or malfunctioning choke wastes gas.

22. During the summer months, adjust the automatic choke for a leaner mixture which will produce faster engine warm-ups.

COOLING SYSTEM

29. Be sure all accessory drive belts are in good condition. Check for cracks or wear.

30. Adjust all accessory drive belts to proper tension.

31. Check all hoses for swollen areas, worn spots, or loose clamps.

32. Check coolant level in the radiator or ex-

pansion tank.

33. Be sure the thermostat is operating properly. A stuck thermostat delays engine warm-up and a cold engine uses nearly twice as much fuel as a warm engine.

34. Drain and replace the engine coolant at least as often as recommended. Rust and scale

TIRES & WHEELS

38. Check the tire pressure often with a pencil type gauge. Tests by a major tire manufacturer show that 90% of all vehicles have at least 1 tire improperly inflated. Better mileage can be achieved by over-inflating tires, but never exceed the maximum inflation pressure on the side of the tire.

39. If possible, install radial tires. Radial tires

deliver as much as 1/2 mpg more than bias belted tires.

40. Avoid installing super-wide tires. They only create extra rolling resistance and decrease fuel mileage. Stick to the manufacturer's recommendations.

41. Have the wheels properly balanced.

omy by tampering with emission controls is more likely to worsen fuel economy than improve it. Emission control changes on modern engines are not readily reversible.

16. Clean (or replace) the EGR valve and

lines as recommended.

17. Be sure that all vacuum lines and hoses are reconnected properly after working under the hood. An unconnected or misrouted vacuum line can wreak havoc with engine performance.

23. Check for fuel leaks at the carburetor, fuel pump, fuel lines and fuel tank. Be sure all lines and connections are tight.

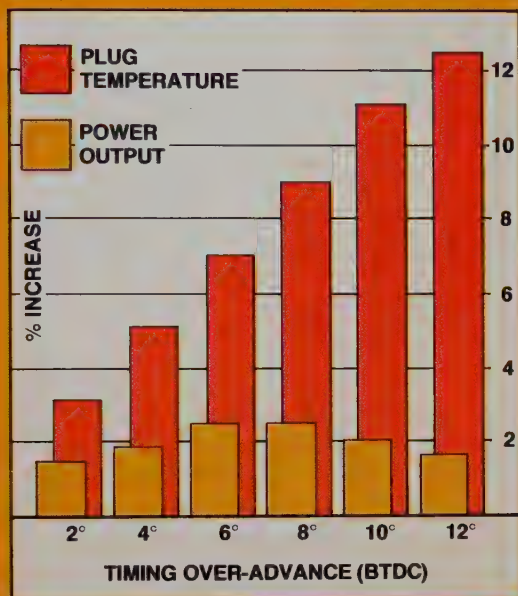
24. Periodically check the tightness of the carburetor and intake manifold attaching nuts and bolts. These are a common place for vacuum leaks to occur.

25. Clean the carburetor periodically and lubricate the linkage.

26. The condition of the tailpipe can be an excellent indicator of proper engine combustion. After a long drive at highway speeds, the inside of the tailpipe should be a light grey in color. Black or soot on the insides indicates an overly rich mixture.

27. Check the fuel pump pressure. The fuel pump may be supplying more fuel than the engine needs.

28. Use the proper grade of gasoline for your engine. Don't try to compensate for knocking or "pinging" by advancing the ignition timing. This practice will only increase plug temperature and the chances of detonation or pre-ignition with relatively little performance gain.



Increasing ignition timing past the specified setting results in a drastic increase in spark plug temperature with increased chance of detonation or pre-ignition. Performance increase is considerably less. (Photo courtesy Champion Spark Plug Co.)

that form in the engine should be flushed out to allow the engine to operate at peak efficiency.

35. Clean the radiator of debris that can decrease cooling efficiency.

36. Install a flex-type or electric cooling fan, if you don't have a clutch type fan. Flex fans use curved plastic blades to push more air at low

speeds when more cooling is needed; at high speeds the blades flatten out for less resistance. Electric fans only run when the engine temperature reaches a predetermined level.

37. Check the radiator cap for a worn or cracked gasket. If the cap does not seal properly, the cooling system will not function properly.

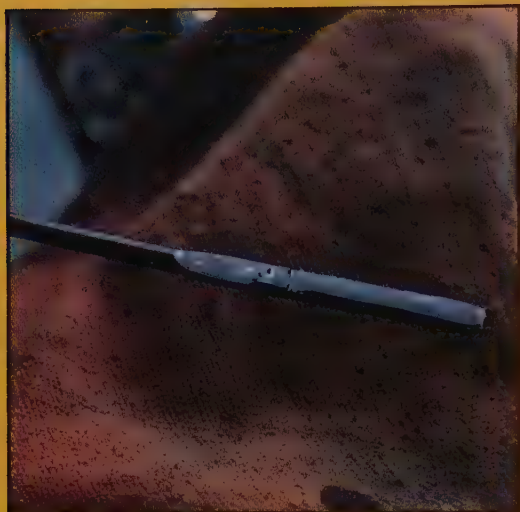
42. Be sure the front end is correctly aligned. A misaligned front end actually has wheels going in different directions. The increased drag can reduce fuel economy by .3 mpg.

43. Correctly adjust the wheel bearings. Wheel bearings that are adjusted too tight increase rolling resistance.

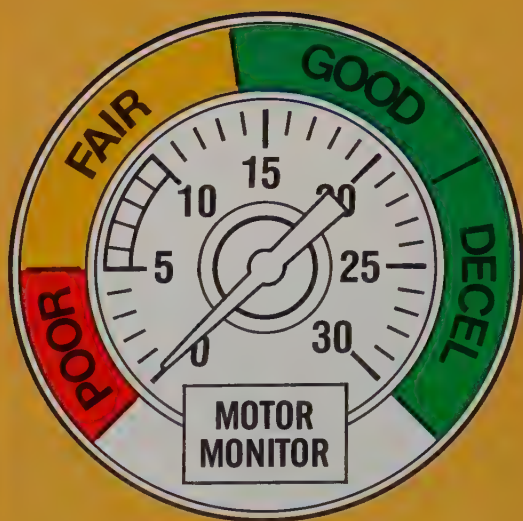


Check tire pressures regularly with a reliable pocket type gauge. Be sure to check the pressure on a cold tire.

GENERAL MAINTENANCE



Check the fluid levels (particularly engine oil) on a regular basis. Be sure to check the oil for grit, water or other contamination.



A vacuum gauge is another excellent indicator of internal engine condition and can also be installed in the dash as a mileage indicator.

44. Periodically check the fluid levels in the engine, power steering pump, master cylinder, automatic transmission and drive axle.

45. Change the oil at the recommended interval and change the filter at every oil change. Dirty oil is thick and causes extra friction between moving parts, cutting efficiency and increasing wear. A worn engine requires more frequent tune-ups and gets progressively worse fuel economy. In general, use the lightest viscosity oil for the driving conditions you will encounter.

46. Use the recommended viscosity fluids in the transmission and axle.

47. Be sure the battery is fully charged for fast starts. A slow starting engine wastes fuel.

48. Be sure battery terminals are clean and tight.

49. Check the battery electrolyte level and add distilled water if necessary.

50. Check the exhaust system for crushed pipes, blockages and leaks.

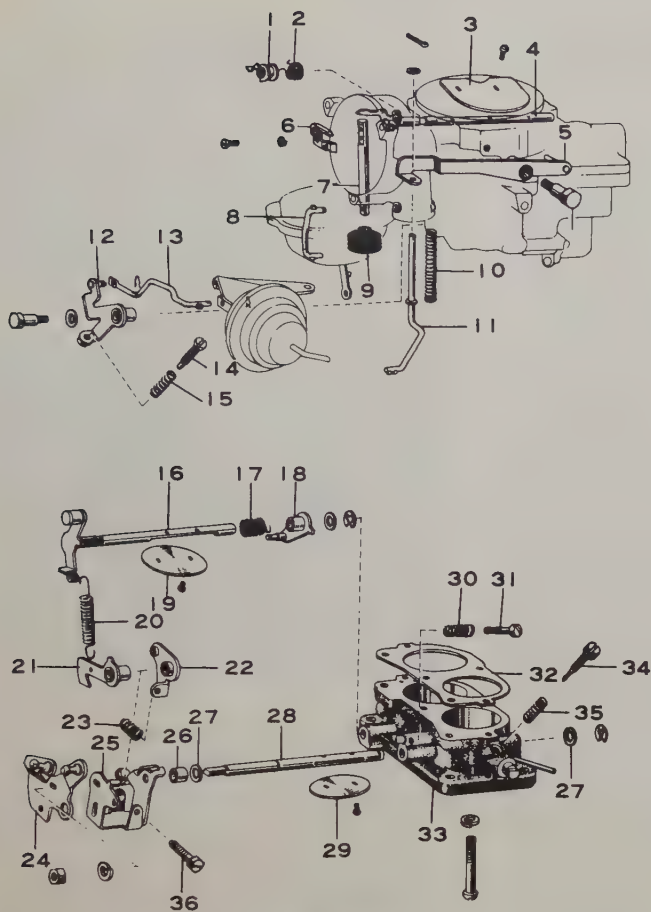
51. Adjust the brakes. Dragging brakes or brakes that are not releasing create increased drag on the engine.

52. Install a vacuum gauge or miles-per-gallon gauge. These gauges visually indicate engine vacuum in the intake manifold. High vacuum = good mileage and low vacuum = poorer mileage. The gauge can also be an excellent indicator of internal engine conditions.

53. Be sure the clutch is properly adjusted. A slipping clutch wastes fuel.

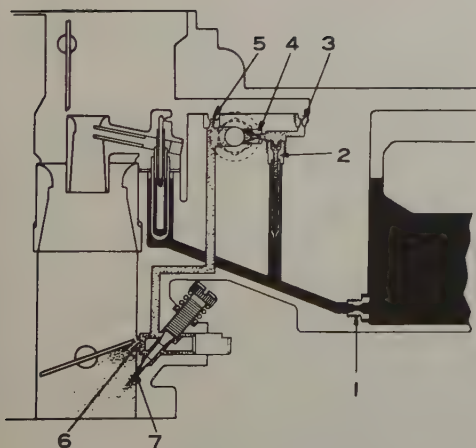
54. Check and periodically lubricate the heat control valve in the exhaust manifold. A sticking or inoperative valve prevents engine warm-up and wastes gas.

55. Keep accurate records to check fuel economy over a period of time. A sudden drop in fuel economy may signal a need for tune-up or other maintenance.



1. Fast idle cam
2. Fast idle cam spring
3. Choke valve
4. Choke shaft
5. Pump lever
6. Fast idle cam follower
7. Sliding rod
8. Connecting link
9. Boot
10. Pump spring
11. Pump connecting link
12. Lever
13. Connector
14. Screw (for T.P.)
15. Spring
16. Second throttle shaft
17. Diaphragm relief spring
18. Diaphragm relief lever
19. Second throttle valve
20. Back spring
21. Second kick lever
22. Fast idle adjusting lever
23. Fast idle adjust spring
24. First throttle lever
25. First throttle shaft arm
26. Collar
27. First throttle shaft shim
28. First throttle shaft
29. First throttle valve
30. Spring
31. Screw
32. Body flange gasket
33. Flange
34. Idle adjusting screw
35. Idle adjusting spring
36. Fast idle adjusting screw

18R-C throttle valve body exploded view



1. First main jet
2. Slow speed jet
3. Air bleed
4. Economizer jet
5. Air bleed
6. Throttle plate
7. Idle port

The idling circuit

a passage for fuel to enter and mix with the small quantity of air which can pass through the throttle plates. The idle speed screw, located below the level of the throttle plate, provides the fuel metering device for the idle circuit.

Progression Circuit

As the throttle valve is opened, vacuum at the idle adjustment orifice is lessened because more air is passing around the throttle plate. With the lower vacuum, less mixture is drawn into the throat at the moment when more air is passing into the manifold. To provide more fuel, one or more orifices are drilled in the carburetor idle passage at points which are in line with the angled throttle plate. These holes, comprising the progression circuit, ensure a smooth transfer from idling to main jet operation. These

holes are easily clogged if dirt enters the carburetor. Clogging of the circuit creates "flat spots" in acceleration.

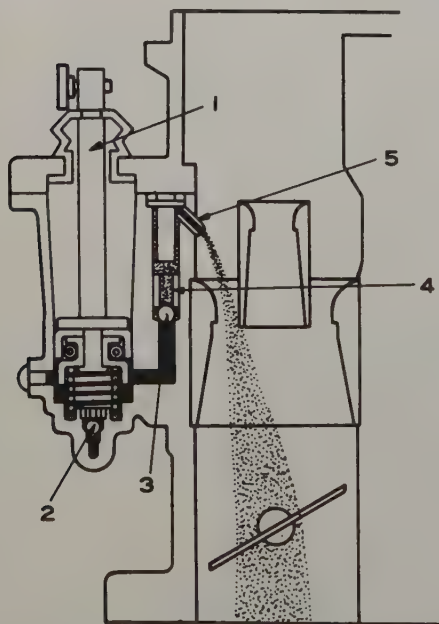
Main Jet Circuit

This circuit supplies the air/fuel mixture for normal engine operation. This circuit is in full operation when the throttle valve is opened and there is sufficient vacuum present in the air horn to draw fuel from the main jet circuit outlet centered in the venturi.

Acceleration Circuit

When the throttle valve is opened, an immediate need for an enriched air/fuel mixture is created. The accelerator pump supplies the engine with an extra squirt of gasoline for this demand period.

As the plunger moves upward, fuel is drawn into the plunger chamber through the strainer and the inlet check valve. When the throttle plate is opened, the accelerator pump plunger is pushed downward discharging fuel through the accelerator jet and into the carburetor.



- | | |
|-----------------------|--------------------------|
| 1. Pump plunger | 4. Pump discharge weight |
| 2. Steel ball; inlet | 5. Accelerator pump jet |
| 3. Steel ball; outlet | |

Acceleration circuit

Power Circuit

This circuit is used to enrich the air/fuel mixture automatically when there are great volumes of air being drawn into the intake man-

ifold. This is the state of the intake system when the engine is under a heavy load or at high speed. When vacuum in the air horn is low, a vacuum piston is released which allows fuel from the float bowl to by-pass the main jet and raise the level in the main well of the carburetor. This allows a richer air/fuel mixture to be drawn into the venturi.

REMOVAL AND INSTALLATION

1. Remove the air cleaner.
 2. Disconnect the fuel line at the carburetor.
 3. Disconnect the automatic choke stove and the distributor vacuum line. On 20R engines, drain approximately two quarts of coolant from the cooling system, then disconnect the choke heater hoses from the choke housing.
 4. On models with an automatic transmission, remove the transmission throttle rod.
 5. Remove the accelerator linkage.
 6. Remove the four bolts holding the carburetor to the intake manifold.
 7. Remove the carburetor and gasket. Cover the intake manifold with a clean rag so that nothing will fall into the intake manifold.
 8. Installation is the reverse of removal.
- NOTE:** Be certain that the carburetor mounting gasket is intact and that it is not cracked or peeling. Leakage of air under the carburetor will cause a rough idle, flooding, stalling, and poor engine operation at higher speeds.

FLOAT LEVEL ADJUSTMENT

With the engine idling, check the fuel level in the carburetor sight glass. If it is even with the line, no adjustment is necessary. If it is not, adjust the float as follows:

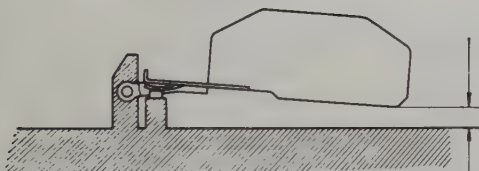
1. Remove and invert the air horn so that the float hangs by its own weight against the air horn. The distance from the tip of the float to the air horn should be 0.37 in. for 8R-C engines, 0.20 in. for 18R-Cs, and 0.197 for 20R engines, 1975-77. The measurement should be 0.276 in. for 1978, and 0.28 in. for 1979-80. The 1981 and later 22R float level is 0.413 in. (raised position) 1.89 in. (lowered position). In all cases, the air horn gasket should be removed before measuring. If the distance is incorrect, adjust the float by bending the center tab, marked "A" in the illustration, on all models except 1978. On 1978 floats only, adjust by bending the metal tab across the two slots and one hole right next to where it enters the float.

2. Raise the float away from the air horn and measure the distance from the needle valve push pin and the float lip. It should measure 0.04 in. Adjust by bending the portion of the float lip marked "B" in the illustration through 1977. On 1978 floats, there is a single center tab resembling the tab marked "A" in the illustration which must be bent to adjust the distance to 0.039 in.

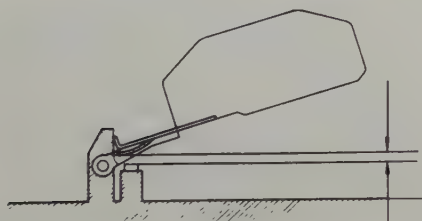
3. Reinstall the air horn.



Float adjusting tabs



Measuring float lever—raised position



Measuring float lever—lowered position

FAST IDLE ADJUSTMENT

Carburetor Removed

This adjustment can only be made with the carburetor removed from the truck. With the carburetor inverted and the choke fully closed, measure the distance from the primary throttle plate to the throttle bore using a wire gauge. It should measure 0.029 in. on 8R-C carburetors, 0.040 in. on 18R-Cs, and 0.047 in. on 20Rs. Adjust the clearance to specifications by turning the fast idle adjustment screw.

Installed—1975 and Later Only

NOTE: Disconnect the EGR vacuum line from the carburetor.

The fast idle can be adjusted on 20R engines only, as part of the idle speed and mixture adjustments outlined in Chapter 2.

1. After adjusting the idle speed and mixture, leave the tachometer attached and shut off the engine.

2. Remove the air cleaner lid.

3. Close the choke. This can be done by opening the throttle slightly and pressing the choke closed with a finger. Allow the throttle to close.

4. Without depressing the accelerator, start the engine.

5. Check the engine speed on the tachometer. It should be 2400 rpm. If not, adjust to specification by turning the fast idle screw.

IDLE SPEED SCREW ADJUSTMENT

Before installing a freshly assembled carburetor make a preliminary idle speed adjustment. Turn the idle speed screw in all the way (until it just contacts the seat) and back it out about 2 turns for the 8R-C engine, 2½ turns from fully closed for the 18R-C engine, and 1¾ turns from fully closed for the 20R and 2½ turns on the 22R.

CAUTION: Do not overtighten the idle speed screw as you will damage the tip.

AUTOMATIC CHOKE ADJUSTMENT

1. Open the choke valve completely.

2. Loosen the three retaining screws on the choke cover.

NOTE: On 20R engines, do not loosen the center bolt on the choke cover, or the coolant will run out.

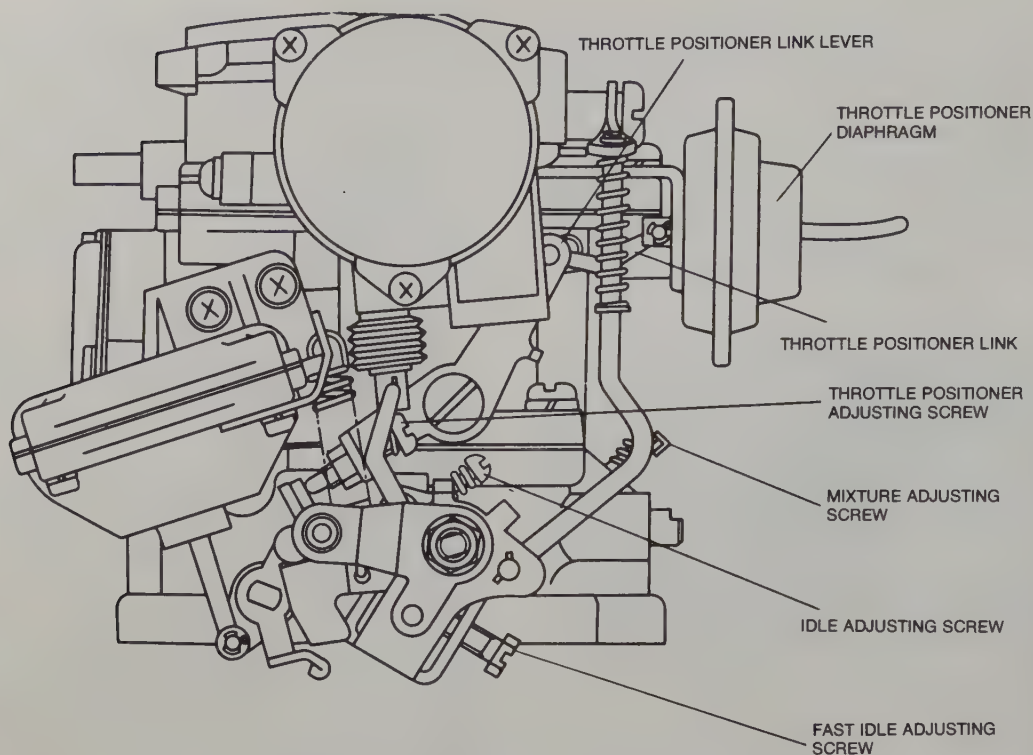
3. Rotate the cover fully counterclockwise and see if the choke valve closes.

4. Set the scale on the housing to the center mark on the housing cover.

5. To change the starting mixture once the carburetor is installed, rotate the housing clockwise to make the mixture leaner and counterclockwise to richen it.

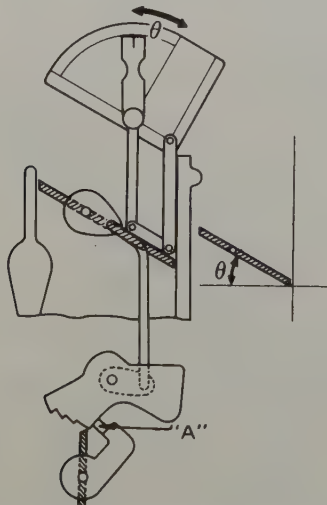
CHOKE UNLOADER ADJUSTMENT

With the choke closed, fully open the throttle valve. The choke should open 51° on the 8R-C engine, 47° on the 18R-C, and 50° on the 20R and 22R. The total angle of choke opening can be measured with a special angle gauge, or with a gauge of the proper angle cut from heavy cardboard.



Carburetor adjustments—18R-C. The 8R-C is identical, except that the idle speed screw is opposite the fast idle screw, instead of above it as shown here

To adjust the amount of choke opening on 8R-C and 18R-C engines, bend either the fast idle cam follower or the choke shaft tab. On 20R engines, bend the fast idle lever, and on 22R engines bend the first throttle arm.



The choke angle can be measured with an angle gauge, as shown here, or with a piece of cardboard cut to the proper angle. On the 20R, bend the fast idle lever at "A" to adjust the unloader angle

CHOKE RELOADER ADJUSTMENT

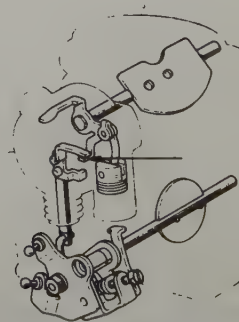
A reloader is used on the 8R-C engine to prevent the throttle valve from opening during automatic choke operation.

1. When the choke valve is opened 50° from the closed position, the reloader lever should disengage from its stop.

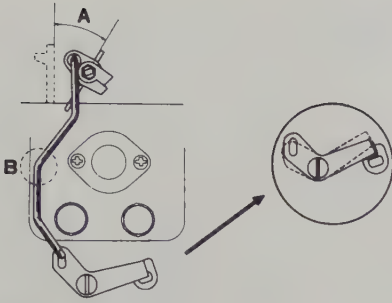
NOTE: Angle "A" in the illustration should be 20° when measured with a gauge.

2. To adjust, bend the portion of the linkage indicated by letter "B".

3. When the primary throttle valve is fully opened, with the reloader in operating posi-



Bend the choke shaft tab to adjust the unloader angle on 8R-C and 18R-C carburetors



Measure the angle at "A" (20°)

tion, the clearance between the secondary throttle valve edge and the bore should be 0.014–0.030 in. Measure the clearance with a wire gauge, and bend the reloader tab to adjust.

4. Fully open the choke valve hand. The reloader lever should be disengaged from its stop by the weight on its link.

CHOKE BREAKER ADJUSTMENT 20R AND 22R ONLY

Push in the choke breaker rod fully to open the choke plate. The choke plate angle should measure 40° (1975–78), 38° (1979 and later). To adjust, bend the relief lever (to the right of the thermostatic index mark).

KICK-UP ADJUSTMENT—18R-C AND 20R ONLY

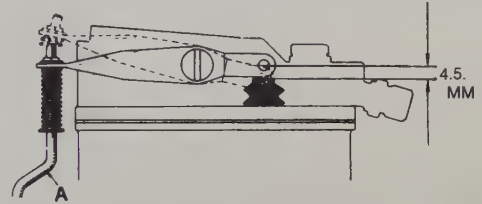
This adjustment must be made with the carburetor removed. With the primary throttle fully opened, check the clearance between the secondary plate and the throttle bore. It should measure 0.008 in. on both 18R-C and 20R engines. Adjust if necessary by bending the secondary throttle lever.

ACCELERATOR PUMP ADJUSTMENT— 18R-C AND 20R ONLY

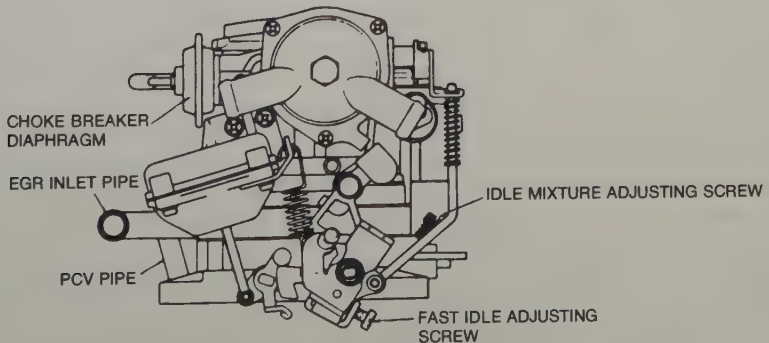
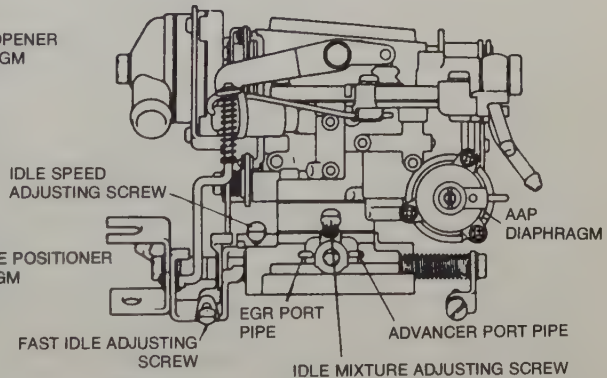
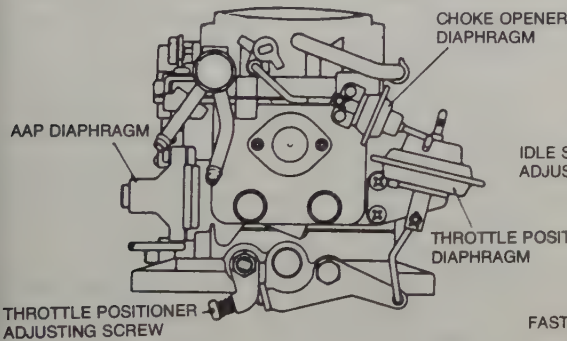
Adjust the amount of pump stroke to 0.177 in. on 18R-C and 1975–79 20R carburetors by bending the pump rod at point "A". The 1980 20R adjustment should be 0.154 in.

OVERHAUL

To overhaul the carburetor, you must first purchase the proper rebuilding kit to supply



Adjust the pump stroke at point "A"



20R carburetor adjustments

Carburetor Specifications

Year	Engine	Float Level Adjustment	Fast Idle Adjustment	Choke Unloader	Choke Reloader	Choke Breaker	Kick Up Adjustment	Accelerator Pump Adjustment
1970-71	8R-C	0.37 in.	0.029 in.	51°	0.014-0.030 in.	—	—	—
1972-74	18R-C	0.20 in.	0.040 in.	47°	—	—	0.008 in.	0.177 in.
1975-78	20R	0.197 in.①	0.047 in.	50°	—	40°	0.008 in.	0.177 in.
1979-80	20R	0.28 in.	0.047 in.	50°	—	38°	0.008 in.	0.177 in.②
1981	22R	0.413 in.③	—	—	—	38°	—	—

① 1978 20R 0.276 in.

② 1980 20R 0.154 in.

③ Raised position; 1.89 lowered position

you with the needed parts. Be prepared when you go out to buy the kit by knowing the exact year and model of your carburetor and by making note of any identifying numbers on the casting. This will make it easier for you to get the right parts. Read the rebuilding instructions carefully and study the exploded drawings. Then proceed to remove the carburetor and disassemble it.

Efficient carburetion depends greatly on careful cleaning and inspection during overhaul since dirt, gum, water, or varnish in or on the carburetor parts are often responsible for poor performance.

Overhaul your carburetor in a clean, dust-free area. Carefully disassemble the carburetor, referring often to the exploded views. Keep all similar and lookalike parts segregated during disassembly and cleaning to avoid accidental interchange during assembly. Make a note of all jet sizes.

When the carburetor is disassembled, wash all parts (except diaphragms, electric choke units, pump plunger, and any other plastic, leather, fiber, or rubber parts) in clean carburetor solvent. Do not leave parts in the solvent any longer than is necessary to sufficiently loosen the deposits. Excessive cleaning may remove the special finish from the float bowl and choke valve bodies, leaving these parts unfit for service. Rinse all parts in clean solvent and blow them dry with compressed air or allow them to air dry. Wipe clean all cork, plastic, leather, and fiber parts with a clean, lint-free cloth.

Blow out all passages and jets with compressed air and be sure that there are no re-

strictions or blockages. Never use wire or similar tools to clean jets, fuel passages, or air bleeds. Clean all jets and valves separately to avoid accidental interchange.

Check all parts for wear or damage. If wear or damage is found, replace the defective parts. Especially check the following:

1. Check the float needle and seat for wear. If wear is found, replace the complete assembly.

2. Check the float hinge pin for wear and the float(s) for dents or distortion. Replace the float if fuel has leaked into it.

3. Check the throttle and choke shaft bores for wear or an out-of-round condition. Damage or wear to the throttle arm, shaft, or shaft bore will often require replacement of the throttle body. These parts require a close tolerance of fit; wear may allow air leakage, which could affect starting and idling.

NOTE: *Throttle shafts and bushings are not included in overhaul kits. They can be purchased separately.*

4. Inspect the idle mixture adjusting needles for burrs or grooves. Any such condition requires replacement of the needle, since you will not be able to obtain a satisfactory idle.

5. Test the accelerator pump check valves. They should pass air one way but not the other. Test for proper seating by blowing and sucking on the valve. Replace the valve if necessary. If the valve is satisfactory, wash the valve again to remove breath moisture.

6. Check the bowl cover for warped surfaces with a straightedge.

7. Closely inspect the valves and seats for wear and damage, replacing as necessary.

8. After the carburetor is assembled, check the choke valve for freedom of operation.

Carburetor overhaul kits are recommended for each overhaul. These kits contain all gaskets and new parts to replace those which deteriorate most rapidly. Failure to replace all parts supplied with the kit (especially gaskets) can result in poor performance later.

After cleaning and checking all components, reassemble the carburetor, using new parts and referring to the exploded view. When reassembling, make sure that all screws and jets are tight in their seats, but do not overtighten, as the tips will be distorted. Tighten all screws gradually, in rotation. Do not tighten needle valves into their seats; uneven jetting will result. Always use new gaskets. Be sure to adjust the float level when reassembling.

Fuel Tank

REMOVAL AND INSTALLATION

1. Remove the negative battery cable.
2. Jack up the vehicle and support it with jack stands.

3. Remove the drain plug and drain into a suitable container.

NOTE: It is best to run the tank as low on fuel as possible before removing it.

4. Disconnect the plug from the sending unit.

5. Disconnect the three fuel lines. Plug the outlet line to prevent fuel from leaking.

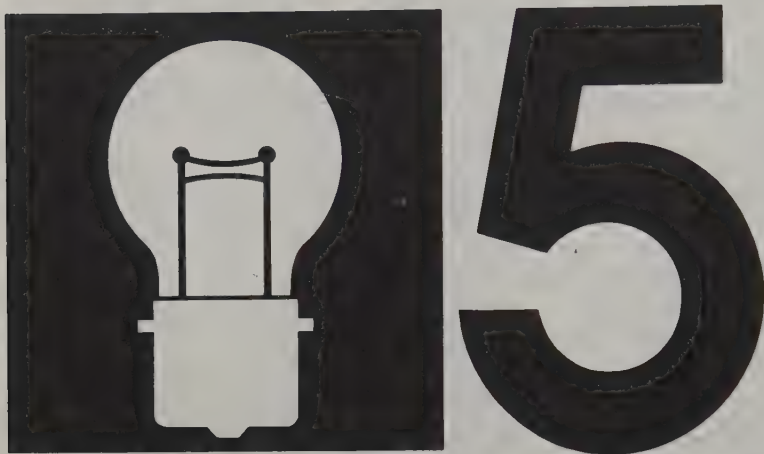
6. Disconnect the filler neck and vent line.

7. Remove the fuel tank protector.

8. Remove the six bolts from the tank and carefully lower the tank.

9. Installation is the reverse of removal. Tighten the six tank bolts to 11–16 ft. lb. This procedure is basically the same on all models.

Chassis Electrical



HEATER

NOTE: On models equipped with air conditioning, the heater and air conditioner are completely separate units. The heater removal procedure is the same as outlined here. However, be certain when working under the dashboard that only the heater hoses are disconnected. The air conditioning hoses are under pressure; if disconnected, the escaping refrigerant will freeze any surface with which it comes in contact, including your skin and eyes. Refer all air conditioning work to a qualified mechanic.

REMOVAL AND INSTALLATION

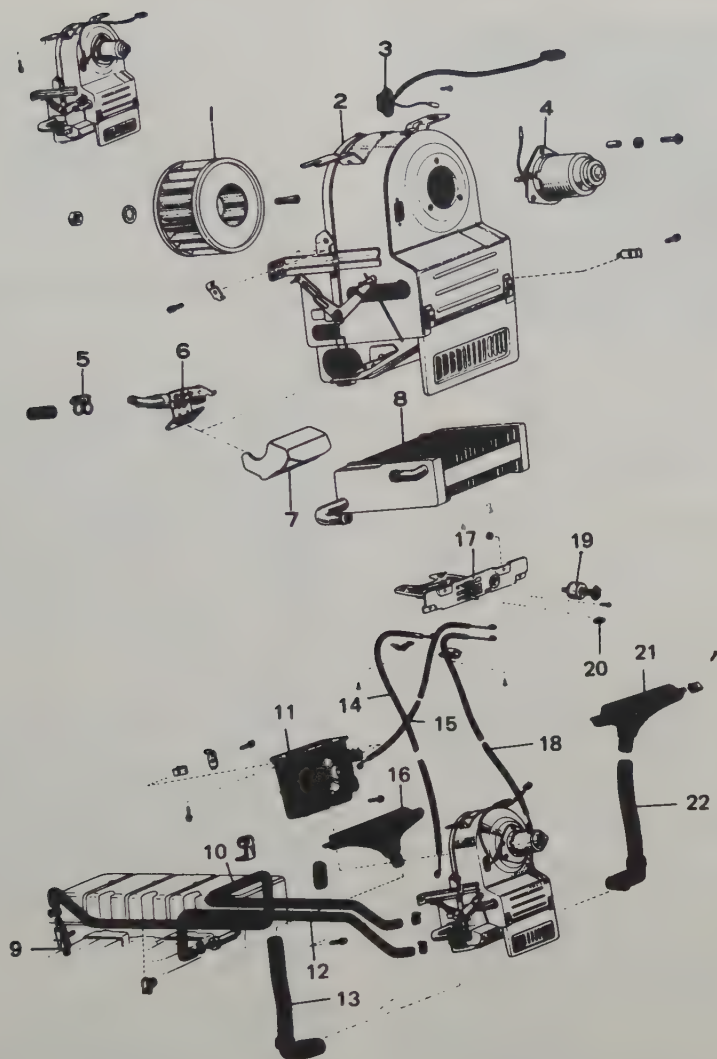
1970-78

The heater core and blower motor are assembled into one unit which is centrally located in the passenger compartment. To effect repairs on either the core or blower motor, remove the entire assembly from the truck and separate the components with the unit removed.

1. Drain the cooling system completely.
2. Remove the package tray from under the dashboard.
3. Unfasten the hose clamps holding the heater hoses to the core.

NOTE: Hold a shallow pan under the hoses so that any water left in them will not run on the floor of the truck

4. Remove the defroster hoses from the heater case.
5. Disconnect the heater control cables from the heater case.
6. Remove the fresh air intake duct.
7. Remove the electrical connector feeding the heater blower motor.
8. There are four bolts holding the assembly to the inside of the cowl. Remove the bolts and withdraw the heater assembly from the passenger compartment.
9. To remove the blower motor, tap the fan retaining nut slightly and then remove the nut from the shaft. Withdraw the fan. Remove the blower motor-to-heater case attaching screws and remove the motor.
10. To remove the core, remove the heater control panel and heater lower case cover as a unit. The core may then be taken out of the heater case.
11. Upon reassembly of the unit be sure to tighten all clamps to prevent leaks. Fill the cooling system with the correct mixture of coolant. With the heater off, run the engine to operating temperature. Open the heater control valve and see if the system is functioning properly.



- | | |
|-------------------------------------|--|
| 1. Heater blower fan subassembly | 12. Heater inlet water hose |
| 2. Heater case | 13. Defroster hose, left |
| 3. Heater blower resistor | 14. Heater control cable subassembly |
| 4. Heater blower motor subassembly | 15. Heater air inlet butterfly cable subassembly |
| 5. Heater radiator unit hose clamp | 16. Defroster nozzle subassembly, left |
| 6. Heater water valve assembly | 17. Heater control base subassembly |
| 7. Heater water valve protector | 18. Defroster control cable subassembly |
| 8. Heater radiator unit subassembly | 19. Heater blower switch assembly |
| 9. Water hose joint | 20. Heater control knob |
| 10. Heater outlet water hose | 21. Defroster nozzle subassembly, right |
| 11. Cowl ventilator duct assembly | 22. Defroster hose, right |

Heater system

1979 and Later

The heater removal is basically the same with the following exceptions.

1. Remove the glove box from the dashboard.
2. Remove the heater controls from the dashboard.
3. Remove the 3 bolts holding the unit in place.

4. To remove the blower motor, remove the three screws on the blower housing and remove the motor.

HEATER CORE REMOVAL AND INSTALLATION

1979 and Later

1. Remove the set screw and the six clips from the heater unit.

- 2. Remove the heater core.
- 3. Installation is the reverse of removal.

RADIO

REMOVAL AND INSTALLATION

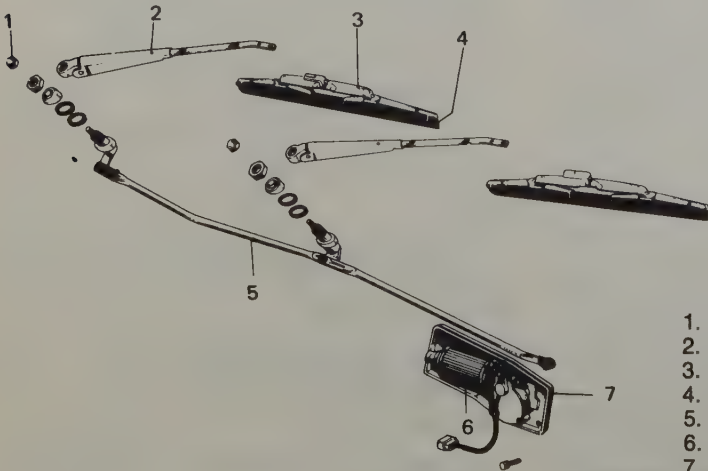
- 1. Disconnect the negative battery cable to prevent damage to the electrical system.
- 2. Remove the radio knobs.
- 3. Using a deep socket of the correct size, loosen the nuts on the radio control shafts.
- 4. Remove the antenna plug-in connection.
- 5. Remove the power source connection.
- 6. Remove the radio support bracket under the dash.
- 7. From under the dash, remove the radio by tilting and then lowering it being careful not to damage any other wiring.

NOTE: After reinstalling the radio be sure to connect the speaker before testing the radio operation. It is often easy to forget to make all the electrical connections. Failure to connect the speaker will result in damage to the output transistors in the radio.

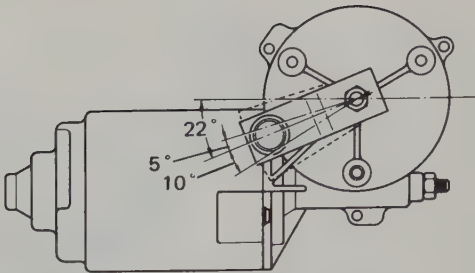
WINDSHIELD WIPERS

BLADE AND ARM REPLACEMENT

When replacing the entire wiper arm and blade assembly use care to avoid damaging the retaining parts of the arm. Loosen the cap nut and then remove the retaining nut underneath. Install a new wiper arm and blade then tighten the retaining nut and install the cap nut. Check the wipers for correct operation.



Windshield wiper components



Installed position of crank arm on wiper motor

Motor

REMOVAL AND INSTALLATION

- 1. Disconnect the negative battery cable.
- 2. Remove the crank arm nut and crank arm from the wiper motor. It is not necessary to unbolt the wiper link assembly from the crank arm.
- 3. Unbolt the wiper motor from the fire-wall.
- 4. Disconnect the electrical connection to the motor.
- 5. When installing the motor the crank arm position must be adjusted to ensure proper wiper action. Use the illustration provided to check the position of the crank arm. If the motor does not return to the illustrated position when power is cut, adjust by shifting the cam plate located below the crank arm.

Linkage

REMOVAL AND INSTALLATION

- 1. Remove the nut at the base of the wiper arm and remove the arm and blade assembly.
- 2. Disconnect the linkage from the wiper crank arm.

3. Insert a screwdriver between the link and arm. Pry the lock from the arm.
4. Disconnect the electrical plug and remove the wiper motor.
5. Remove the nuts that hold the pivot arms and remove the linkage.
6. Installation is the reverse of removal.

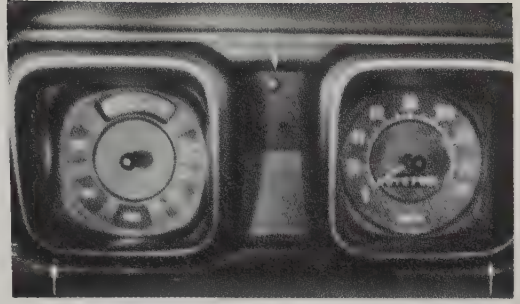
INSTRUMENT CLUSTER

The combination meter which houses the speedometer, fuel and oil pressure gauges, and so forth may be removed easily.

1. Loosen the steering column clamp bolts at the base of the instrument panel. This will allow the steering column to drop slightly.
2. Remove the three retaining screws on the instrument group and pull out gently on the hood of the cluster.
3. Disconnect the speedometer cable and the wiring connector and withdraw the cluster.

SPEEDOMETER CABLE REPLACEMENT

1. Remove the instrument cluster and disconnect the cable at the speedometer.
2. Disconnect the other end of the speedometer cable at the transmission extension housing and pull the cable from its jacket at the transmission end. If you are replacing the cable because it is broken, don't forget to remove both pieces of the broken cable.
3. Lubricate the new cable with graphite speedometer cable lubricant, and feed it into the cable jacket from the lower end.



Location of cluster retaining screws

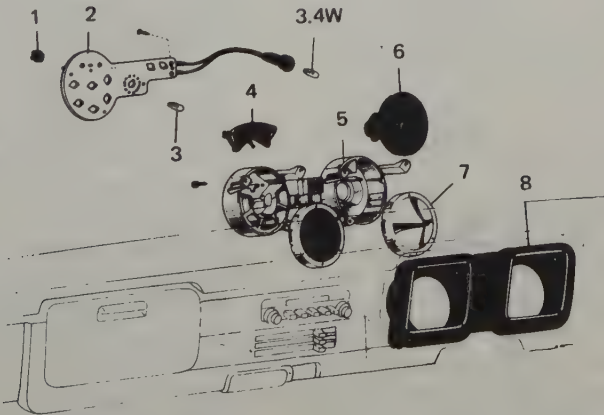
4. Connect the cable to the transmission, then to the speedometer. Plug the electrical connector into the instrument cluster, and replace the cluster.

LIGHTING

The headlights are of the sealed beam type mandatory in the United States.

REMOVAL AND INSTALLATION

1. On 1970–72 models, remove the three trim cover retaining screws, and remove the cover. On later models, the half of the grille covering the affected unit must be removed. There are seven retaining screws on 1973–74 trucks, and six screws 1975 and later (one is hidden behind the grille emblem).
2. Loosen the three headlight ring retaining screws, but do not remove them. Turn the retaining ring clockwise and pull out the headlight with the ring.



- | | |
|------------------------------------|---------------------------|
| 1. Meter bulb socket subassembly | 5. Combination meter body |
| 2. Meter circuit plate subassembly | 6. Speedometer assembly |
| 3. Bulb (3.4W) | 7. Combination meter lens |
| 4. Fuel level gauge assembly | 8. Meter front hood |

Instrument cluster—1973 and later

Bulb Replacement Chart

Bulb Location	Bulb Trade Number
Sealed beam—outer	4002
Sealed beam—inner	4001
Front turn signal and parking	1157
Side markers—front and rear	67
Rear turn signal	1073
Stop and taillight combination	1157
Back-up lights	1073
License Plate	89
Interior	12V-5W-3CP

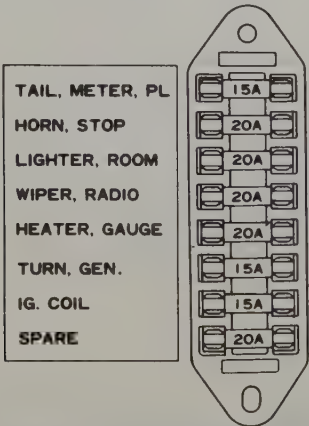
3. Unplug the electrical connector from the rear of the headlight, and remove the headlight from the ring.

Installation is the reverse of removal.

NOTE: Do not interchange the inner and outer headlights.

CAUTION: Do not disturb the headlight aiming screws located on the retaining ring mounting plate.

All other bulbs on the vehicle are replaced by removing the screws retaining the lens and twisting out the defective bulb.



Fuse box connections— 1973 and later

CIRCUIT PROTECTION

Fusible Links

All electrical circuits, except for the starter, are protected by two fusible links connected to the positive terminal of the battery. One is used exclusively for the headlight circuit, for which no fuse is used. The other is connected to the main electrical wiring harness, and protects those circuits from high current surges.

FUSE LINK

The fuse link is a short length of special, Hypalon (high temperature) insulated wire, integral with the engine compartment wiring harness and should not be confused with standard wire. It is several wire gauges smaller than the circuit which it protects. Under no circumstances should a fuse link replacement repair be made using a length of standard wire cut from bulk stock or from another wiring harness.

To remain any blown fuse link use the following procedure:

1. Determine which circuit is damaged, its location and the cause of the open fuse link. If the damaged fuse link is one of three fed by a common No. 10 or 12 gauge feed wire, determine the specific affected circuit.
2. Disconnect the negative battery cable.
3. Cut the damaged fuse link from the wiring harness and discard it. If the fuse link is one of three circuits fed by a single feed wire, cut it out of the harness at each splice end and discard it.
4. Identify and procure the proper fuse link and butt connectors for attaching the fuse link to the harness.
5. To repair any fuse link in a 3-link group with one feed:

a. After cutting the open link out of the harness, cut each of the remaining undamaged fuse links close to the feed wire weld.

b. Strip approximately ½ inch of insulation from the detached ends of the two good fuse links. Then insert two wire ends into one end of a butt connector and carefully push one stripped end of the replacement fuse link into the same end of the butt connector and crimp all three firmly together.

NOTE: Care must be taken when fitting the three fuse links into the butt connector as the internal diameter is a snug fit for three wires. Make sure to use a proper crimping tool. Pliers, side cutters, etc. will not apply the proper crimp to retain the wires and withstand a pull test.

c. After crimping the butt connector to the three fuse links, cut the weld portion from the feed wire and strip approximately ½ inch of insulation from the cut end. Insert the stripped end into the open end of the butt connector and crimp very firmly.

d. To attach the remaining end of the replacement fuse link, strip approximately ½ inch of insulation from the wire end of

the circuit from which the blown fuse link was removed, and firmly crimp a butt connector or equivalent to the stripped wire. Then, insert the end of the replacement link into the other end of the butt connector and crimp firmly.

e. Using resin core solder with a consistency of 60 percent tin and 40 percent lead, solder the connectors and the wires at the repairs and insulate with electrical tape.

6. To replace any fuse link on a single circuit in a harness, cut out the damaged portion, strip approximately $\frac{1}{2}$ inch of insulation from the two wire ends and attach the appropriate replacement fuse link to the stripped wire ends with two proper size butt connectors. Solder the connectors and wires and insulate with tape.

7. To repair any fuse link which has an eyelet terminal on one end such as the charging circuit, cut off the open fuse link behind the weld, strip approximately $\frac{1}{2}$ inch of insulation from the cut end and attach the appropriate new eyelet fuse link to the cut stripped wire with an appropriate size butt connector. Solder the connectors and wires at the repair and insulate with tape.

8. Connect the negative battery cable to the battery and test the system for proper operation.

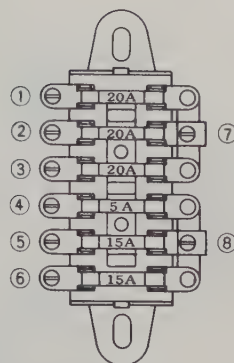
NOTE: Do not mistake a resistor wire for a fuse link. The resistor wire is generally longer and has print stating, "resistor—don't cut or splice."

NOTE: When attaching a single No. 16, 17, 18 or 20 gauge fuse link to a heavy gauge wire, always double the stripped wire end of the fuse link before inserting and crimping it into the butt connector for positive wire retention.

Fuses and Flashers

FUSES

The fuse block is located on the inner fender well on 1970–72 trucks, and below the left side of the instrument panel 1973 and later.



1. Headlight, parking and interior lights
2. Horn, stop light, lighter
3. Hazard warning lights
4. Instrument warning lights, gauges, and back-up lights
5. Wiper motor and heater blower
6. Turn signals
7. From battery
8. From ignition switch

Fuse block—1970–72

In addition, the radio is protected by a separate fuse located in the wire between the radio and the fuse block.

If a fuse should blow, turn off the ignition switch and also the circuit involved. Replace the fuse with one of the same amperage rating, and turn on the switches. If the new fuse immediately blows out, the circuit should be tested for shorts, broken insulation, or loose connections.

NOTE: Do not use fuses of a higher amperage than recommended.

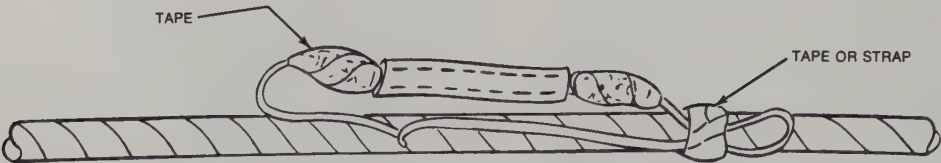
FLASHERS AND RELAYS

The headlight control relay (1973 and later only) is located next to the fuse block under the left side of the instrument panel.

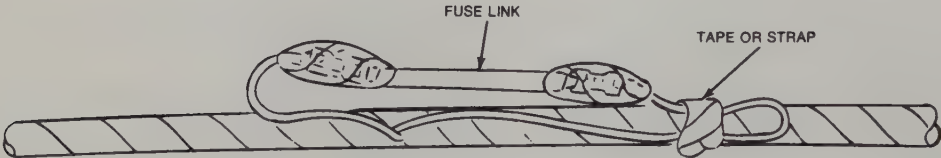
The turn signal flasher is installed on the center portion of the back side of the instrument panel. The hazard warning flasher is wired into the turn signal flasher, and so has no flasher unit of its own.

The turn signal flasher and hazard warning flasher are separate units on 1970–72 trucks. They are located on the inner fender of the engine compartment, next to the fuse block.

REMOVE EXISTING VINYL TUBE SHIELDING
REINSTALL OVER FUSE LINK BEFORE CRIMPING
FUSE LINK TO WIRE ENDS



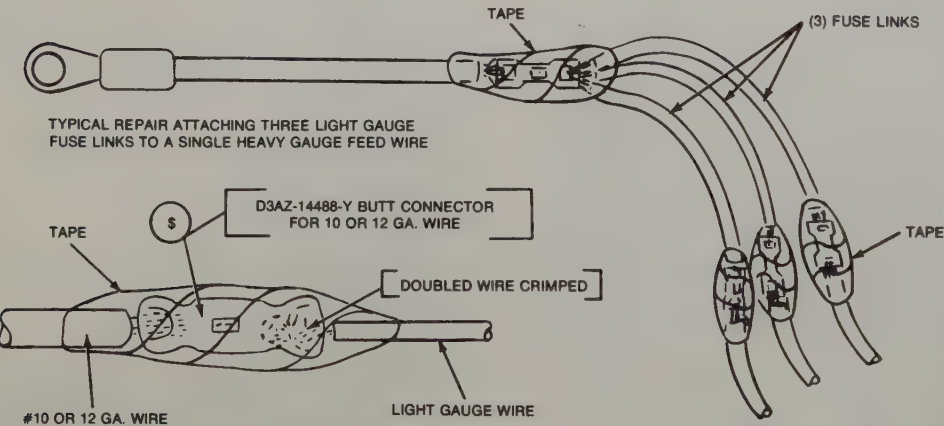
TYPICAL REPAIR USING THE SPECIAL #17 GA. (9.00' LONG-YELLOW) FUSE LINK REQUIRED FOR THE AIR/COND. CIRCUITS (2) #687E and #261A LOCATED IN THE ENGINE COMPARTMENT



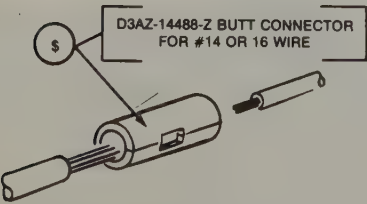
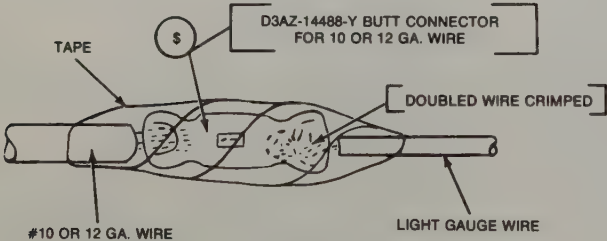
TYPICAL REPAIR FOR ANY IN-LINE FUSE LINK USING THE SPECIFIED GAUGE FUSE LINK FOR THE SPECIFIC CIRCUIT



TYPICAL REPAIR USING THE EYELET TERMINAL FUSE LINK OF THE SPECIFIED GAUGE FOR ATTACHMENT TO A CIRCUIT WIRE END

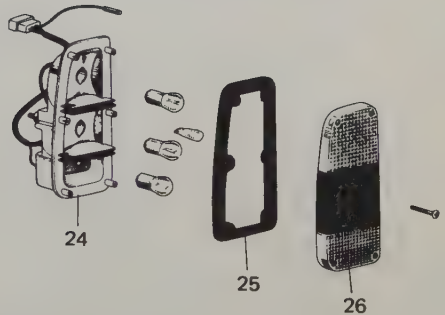
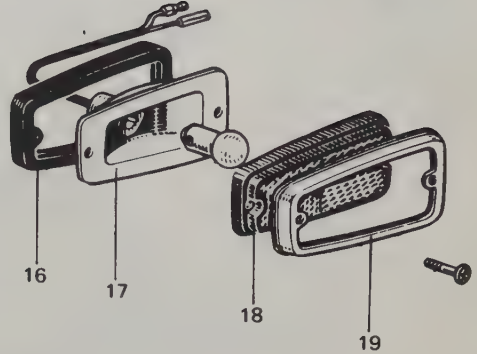
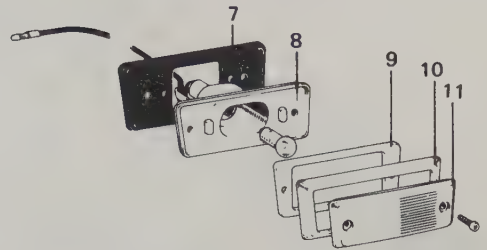
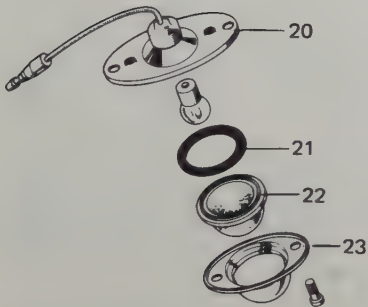
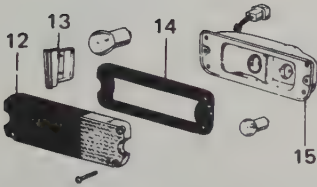
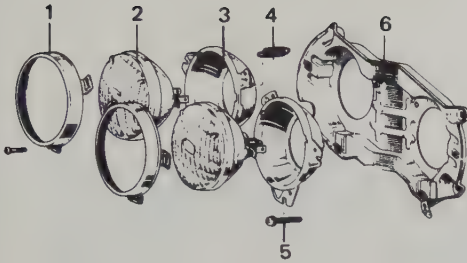


TYPICAL REPAIR ATTACHING THREE LIGHT GAUGE FUSE LINKS TO A SINGLE HEAVY GAUGE FEED WIRE



FUSIBLE LINK REPAIR PROCEDURE

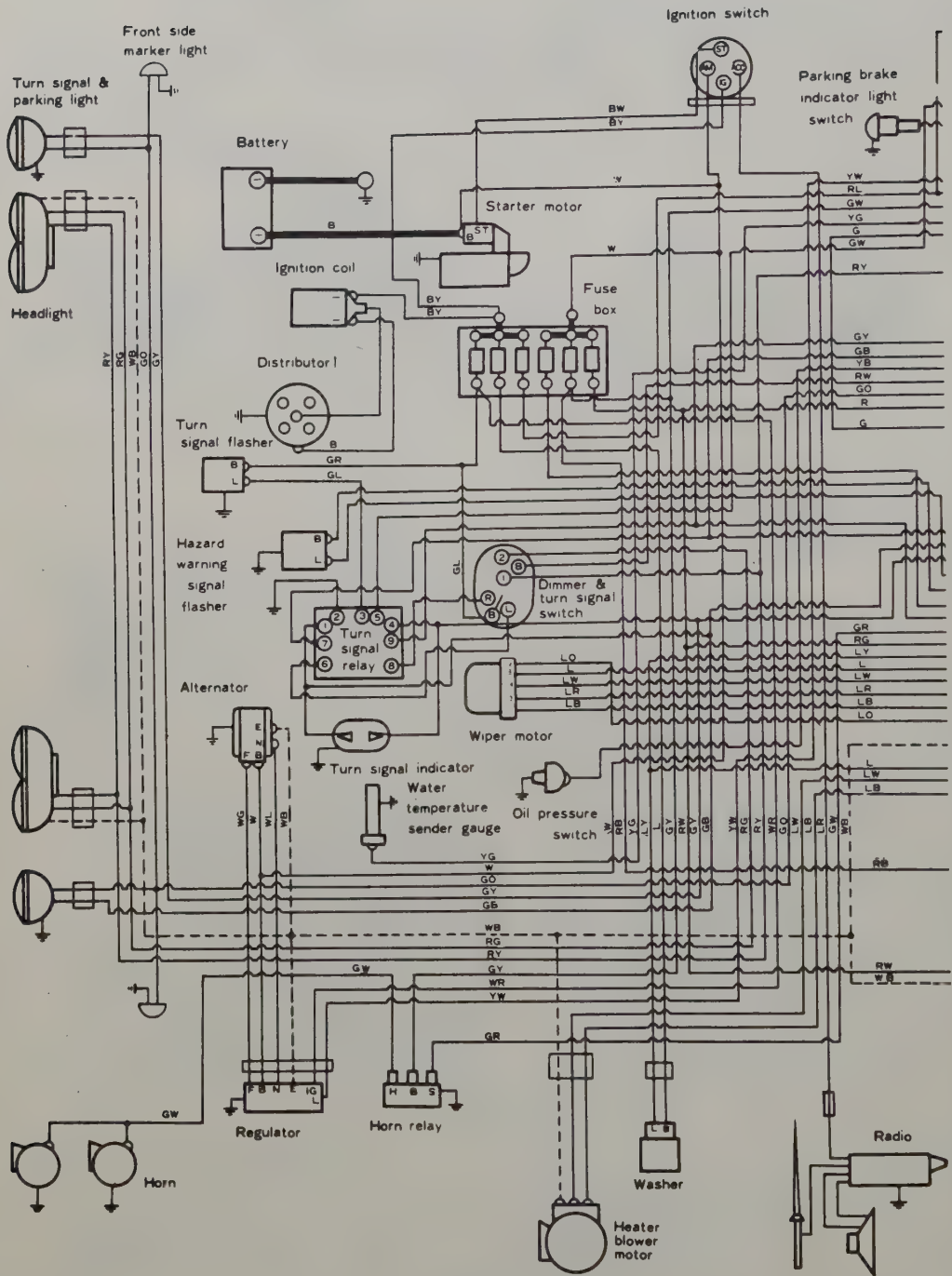
General fuse link repair procedure

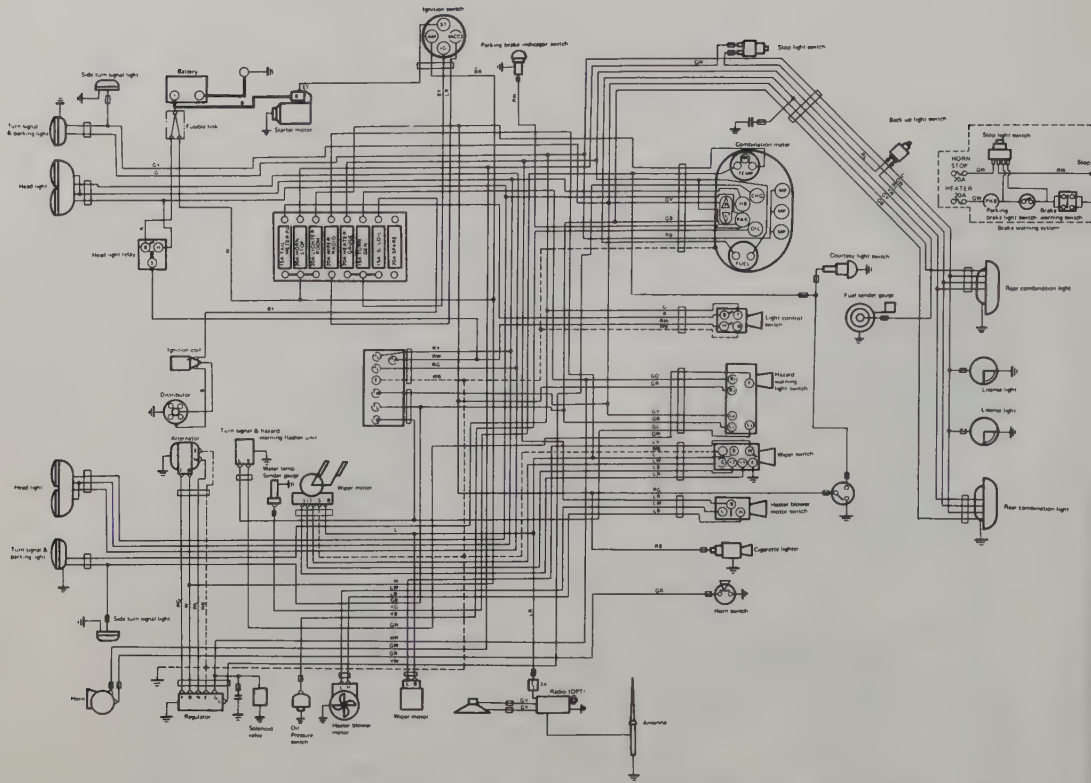


1. Sealed beam retaining ring
2. Sealed beam unit
3. Sealed beam mounting ring
4. Tension spring
5. Headlight adjusting screw
6. Headlight housing subassembly
7. Side turn signal light body packing
8. Side turn signal light body
9. Side turn signal lens gasket
10. Side turn signal light rim
11. Side turn signal light lens
12. Front turn signal light lens
13. Front turn signal light shade

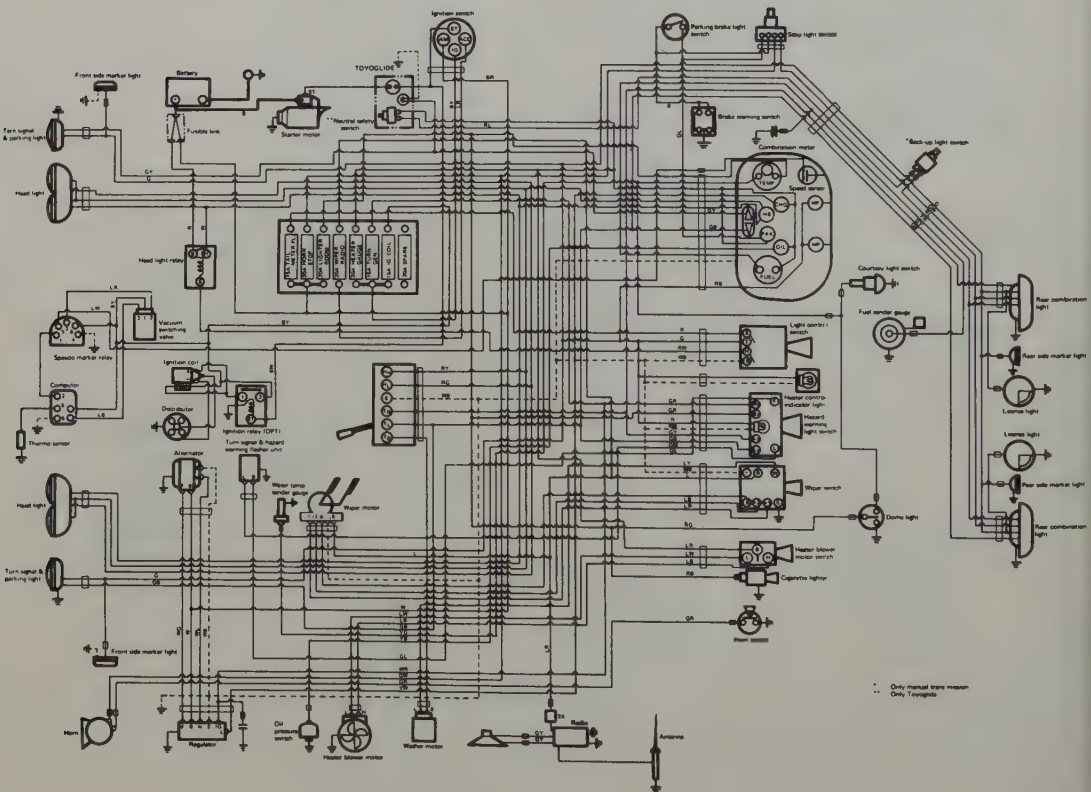
14. Front turn signal light gasket
15. Front turn signal light body
16. Rear side marker light body gasket
17. Rear side marker light body
18. Rear side marker light lens
19. Rear side marker light rim
20. License plate light body
21. License plate light packing
22. License plate light lens
23. License plate light cover
24. Rear combination light body
25. Rear combination light gasket
26. Rear combination light lens

Lighting components

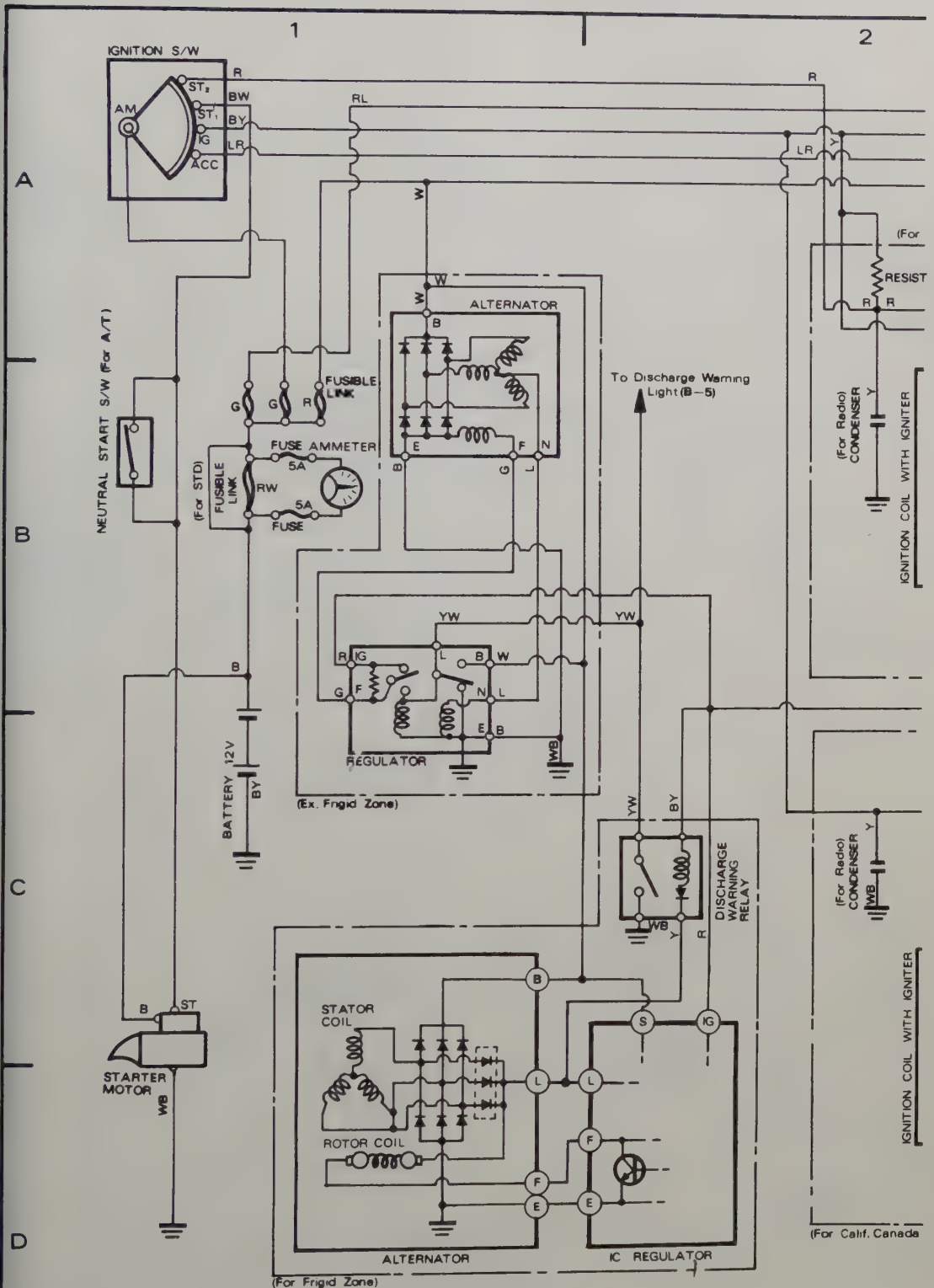




1973-74 and 1977-78. The brake light warning system is shown inset in dotted lines

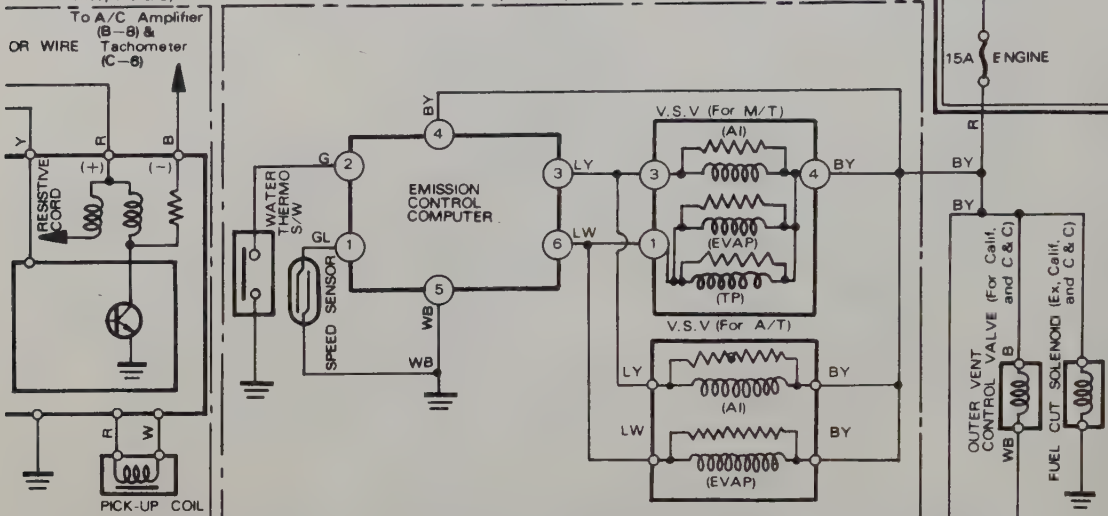


1975-76

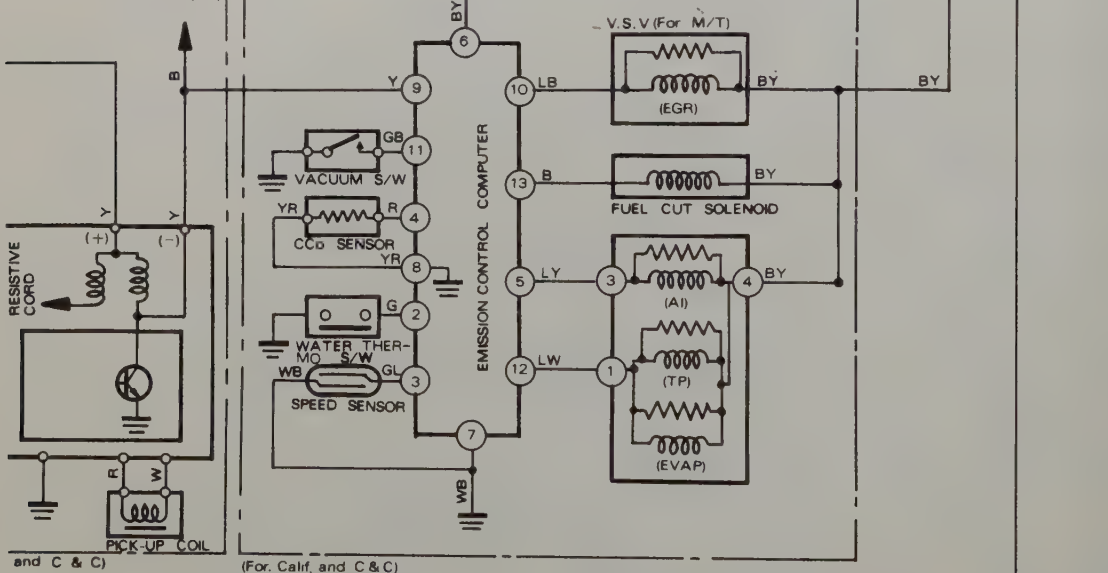


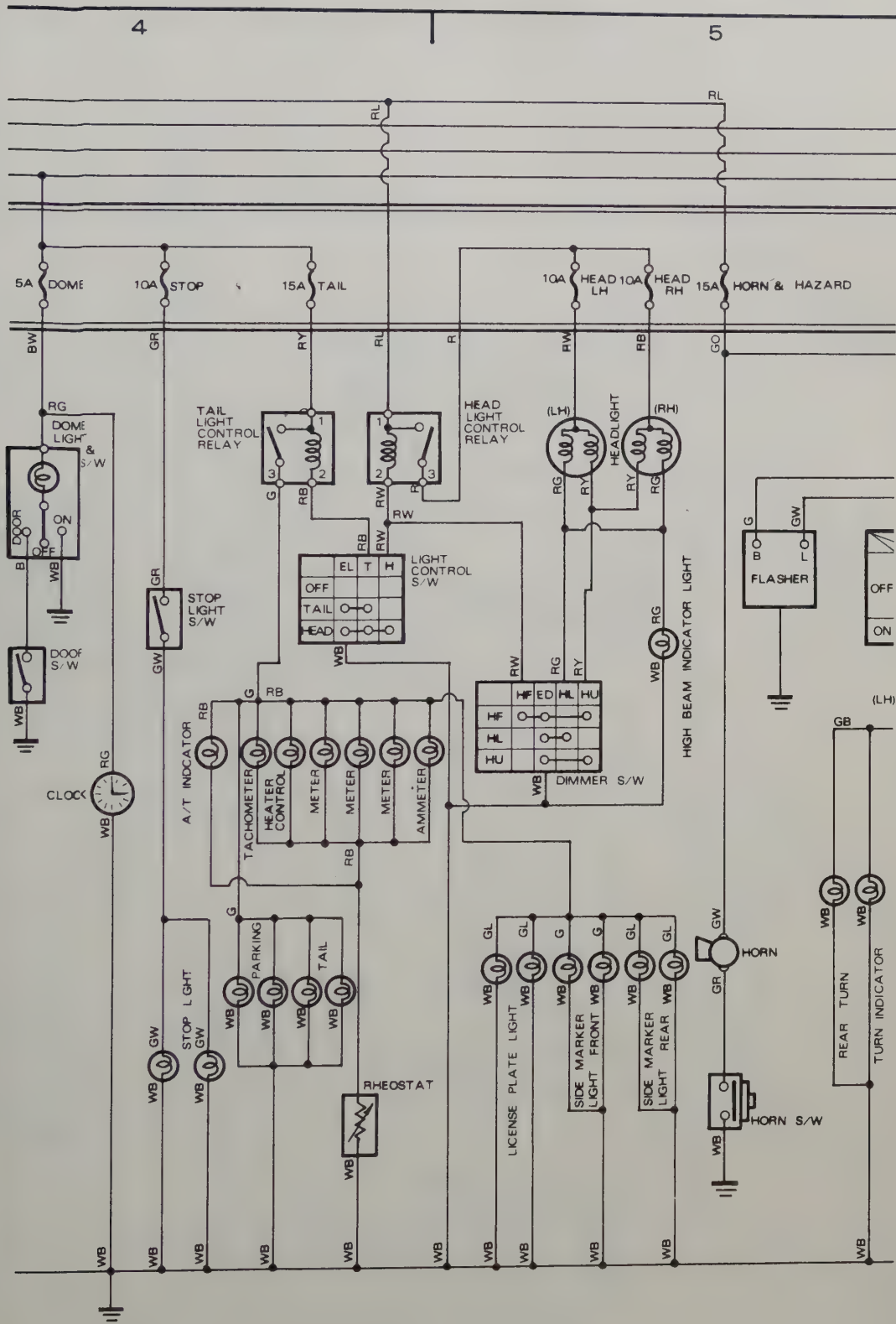
Federal except C & C)

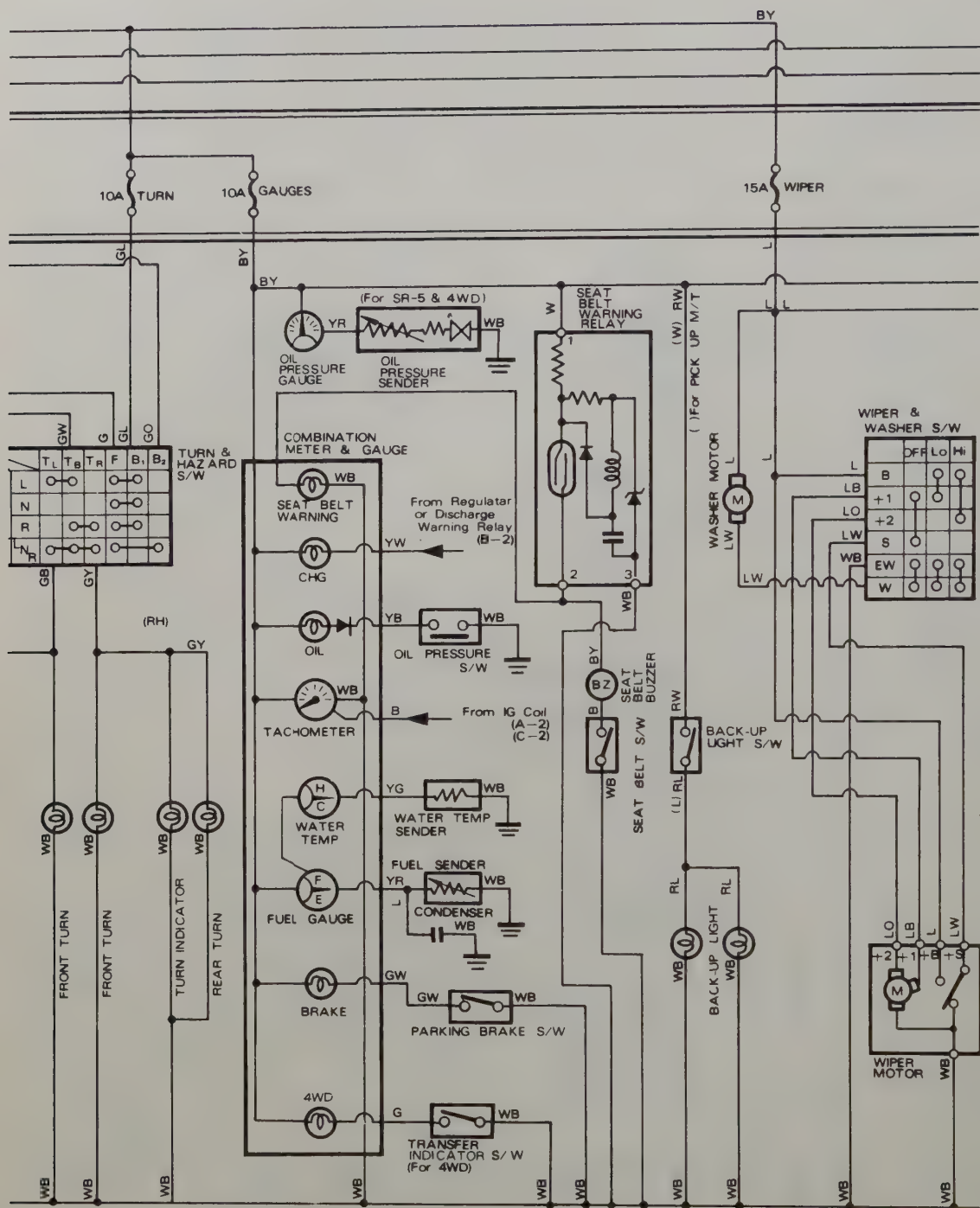
(For Federal and Canada 4x2 except C & C)



To A/C Amplifier (B-8) & Tachometer (C-6)







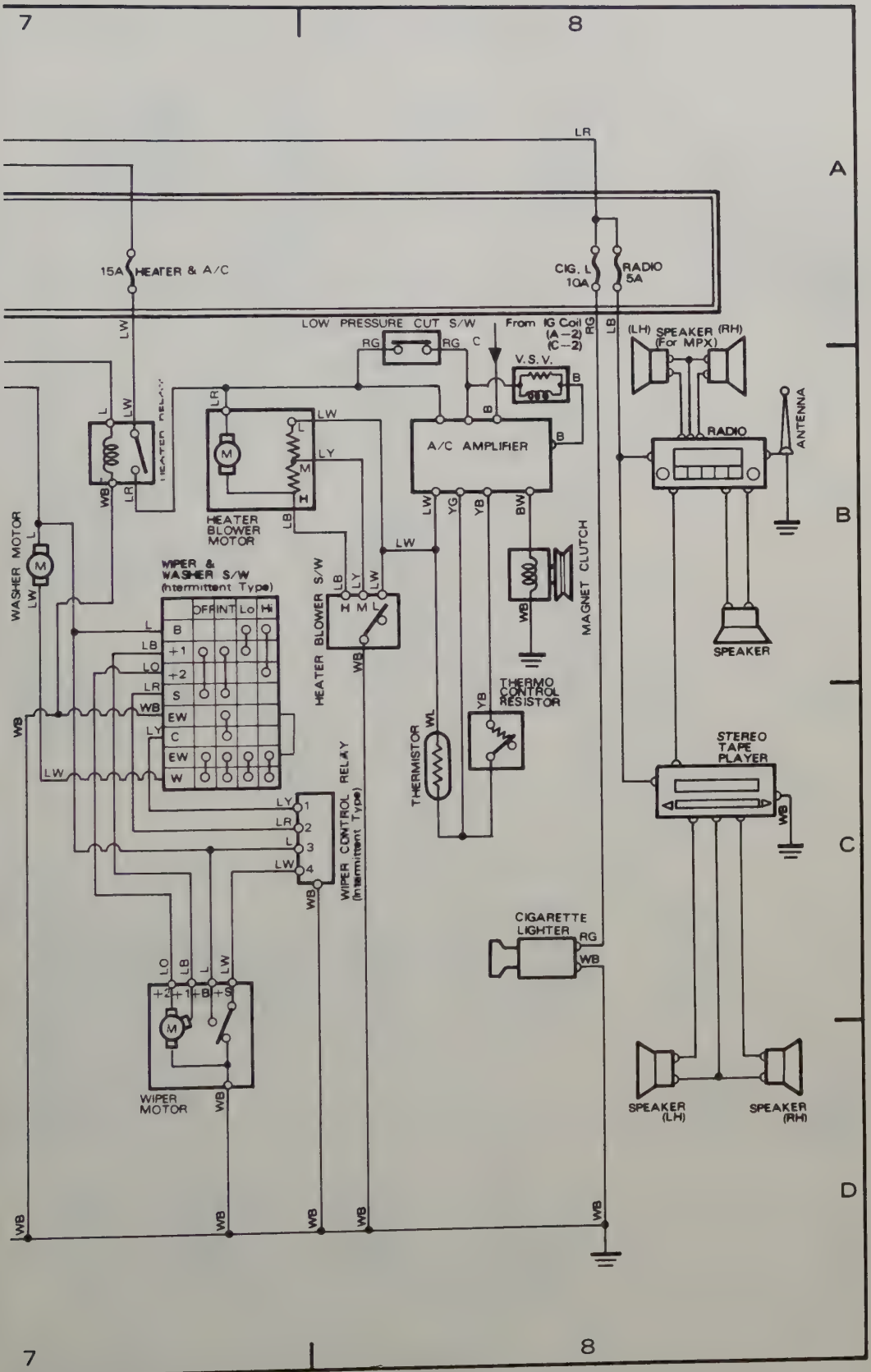
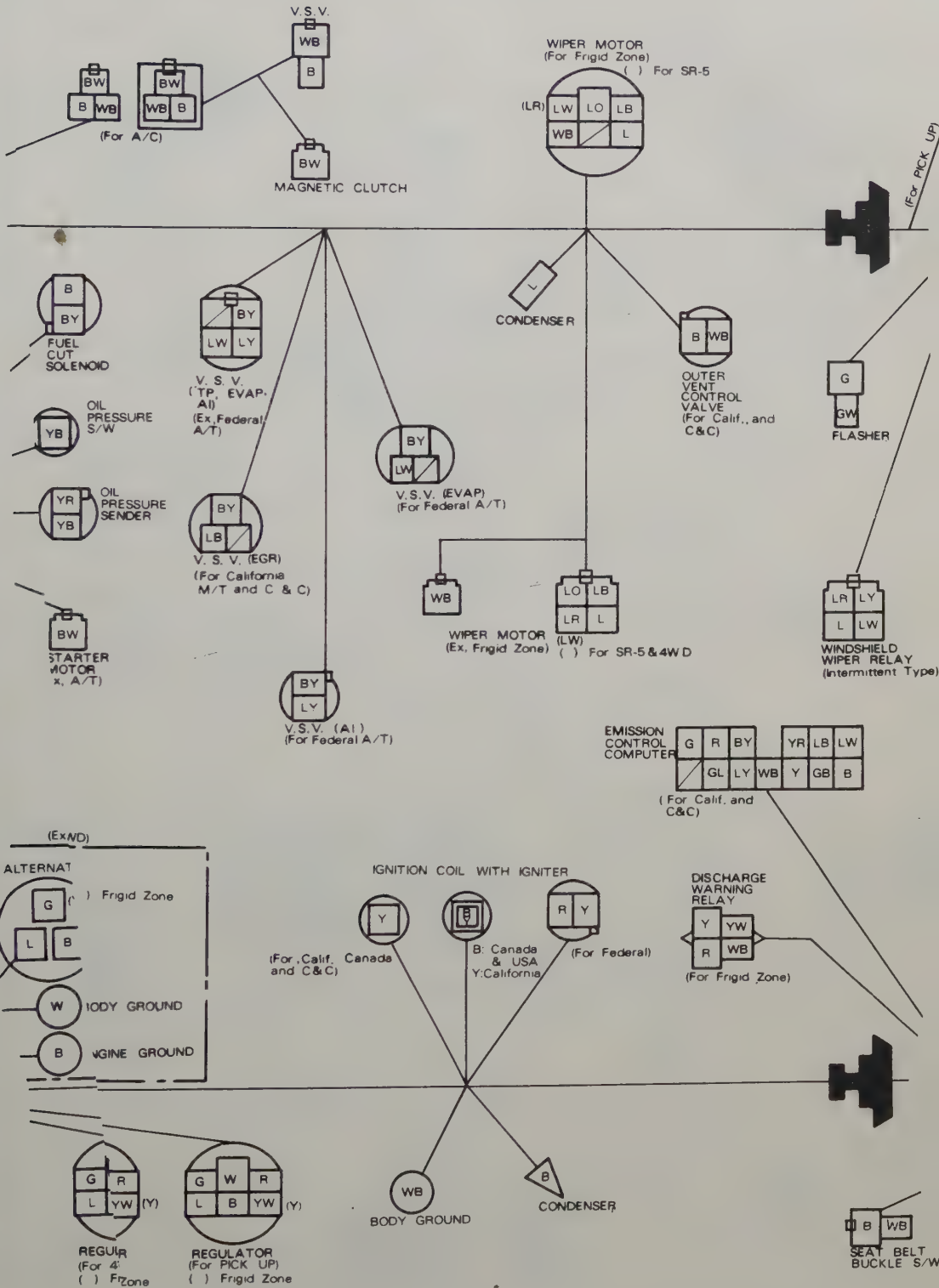


FIG. 2



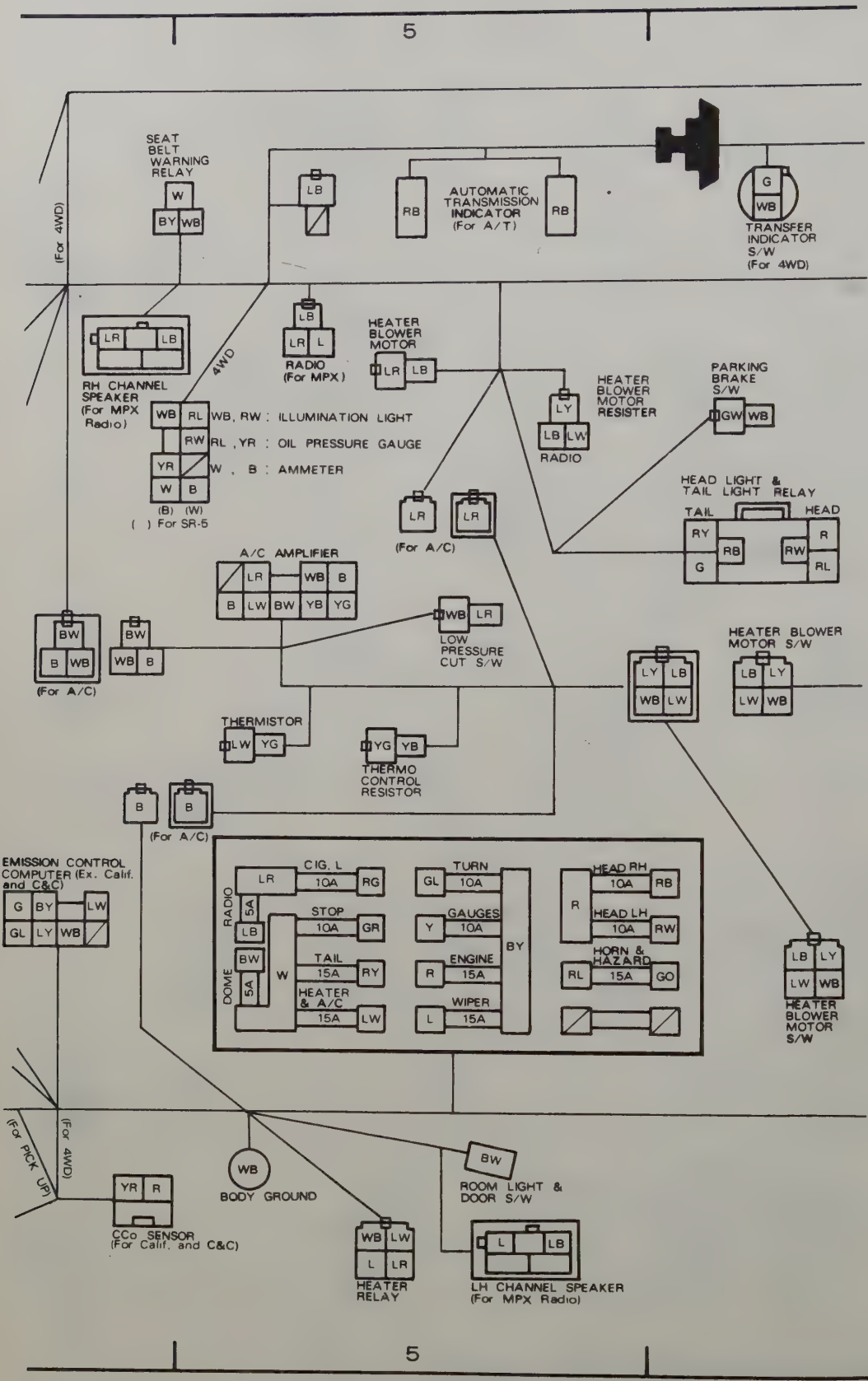
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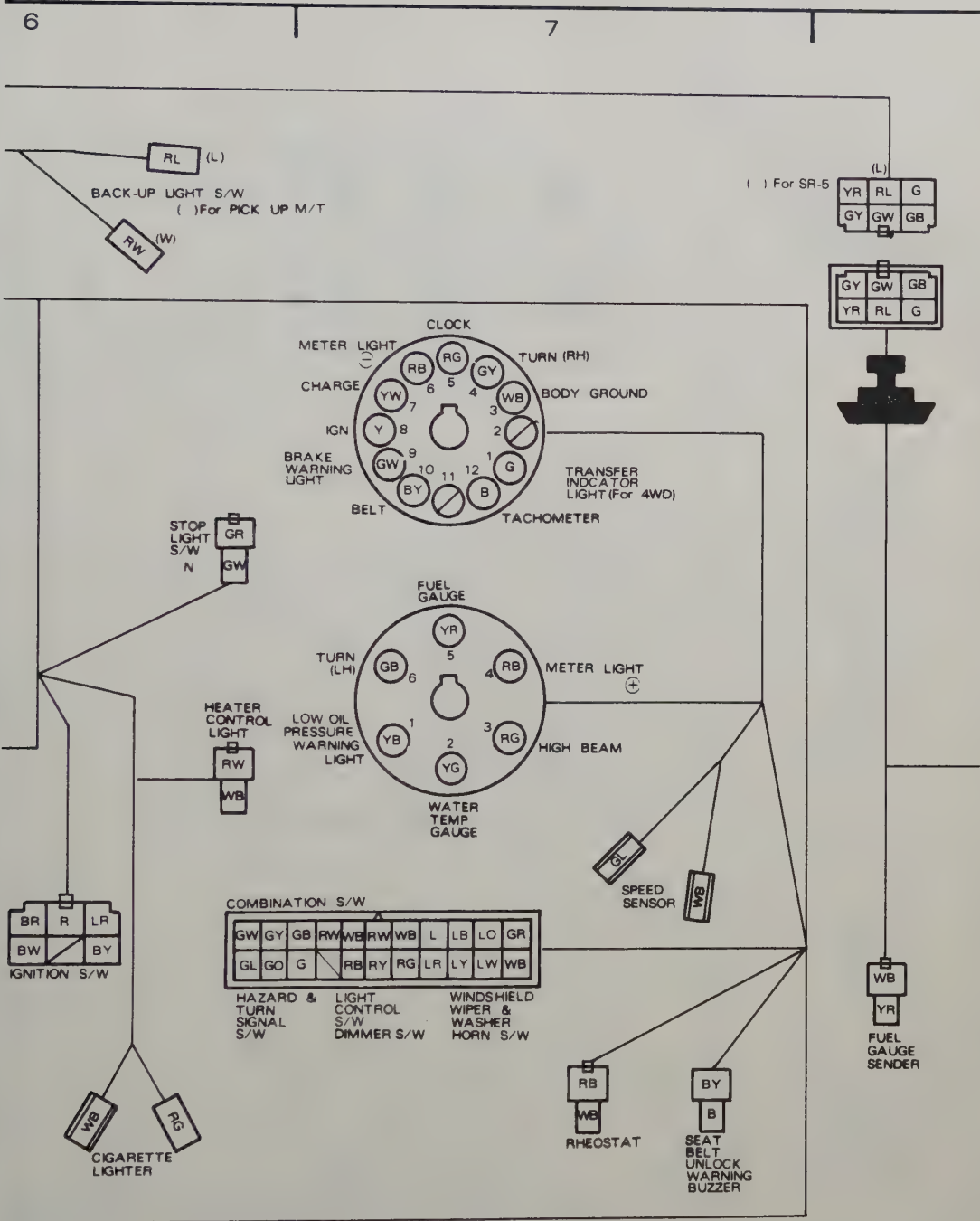
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3

4

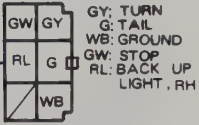




REAR

8

REAR COMBINATION LIGHT



A

RH



REAR SIDE MARKER LIGHT, RH

B



LICENSE PLATE LIGHT



BODY GROUND



LICENSE PLATE LIGHT

C



REAR SIDE MARKER LIGHT, LH

REAR COMBINATION LIGHT

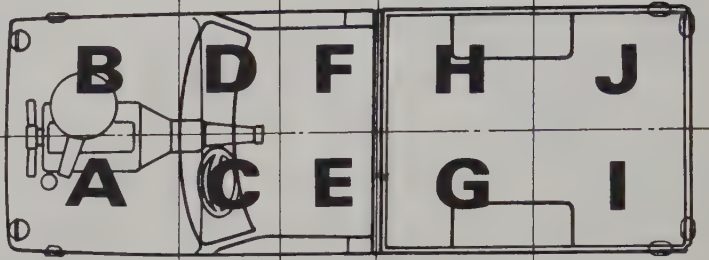


D

LH

8

FIG. 3



Wiring color code is shown with alphabetical letter/s. The first letter indicates the basic color for the wire, and the second letter indicates the spiral line color.

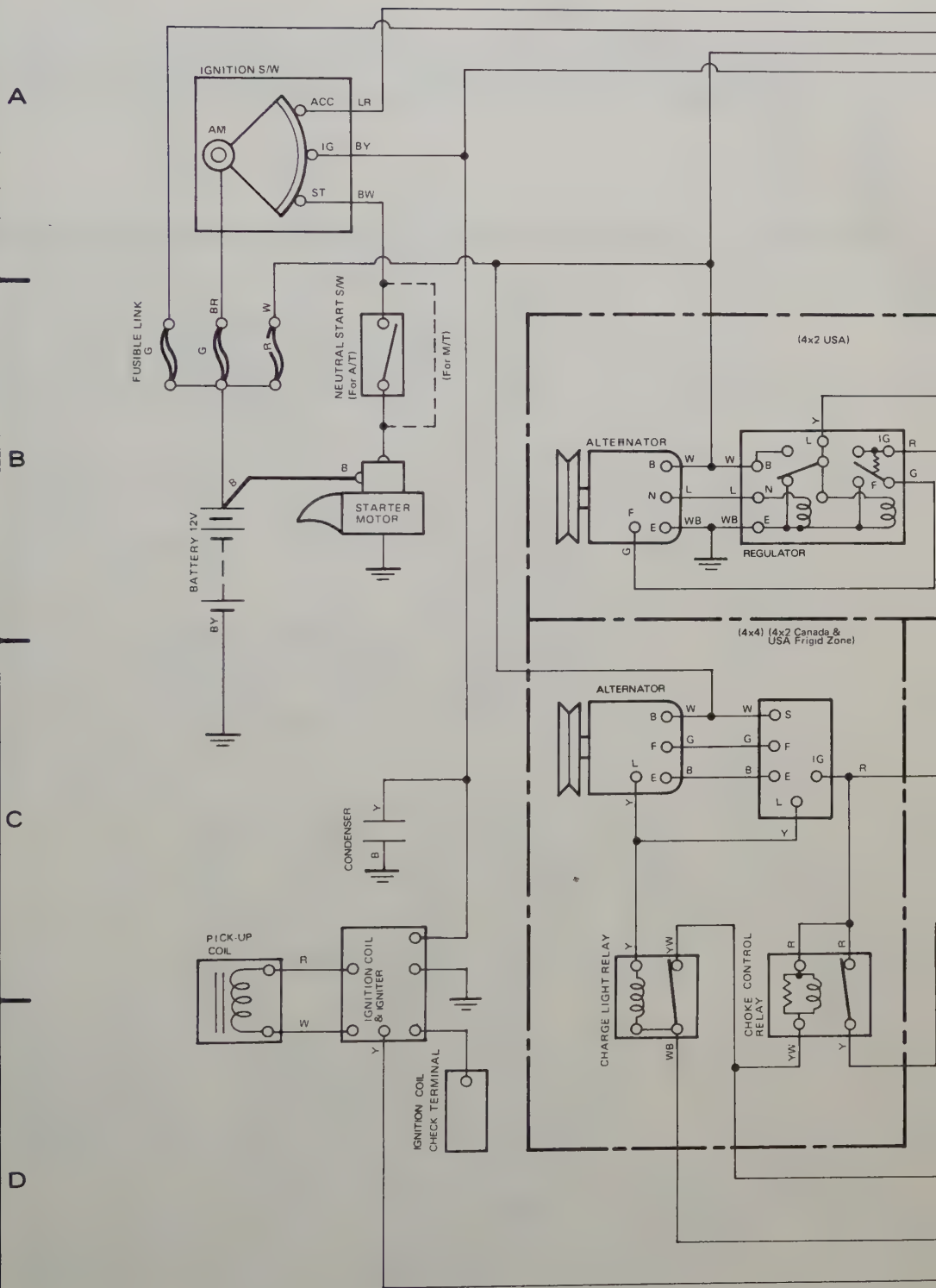
B = Black	Lg = Light Green
Br = Brown	O = Orange
G = Green	R = Red
Gr = Grey	W = White
L = Light Blue	Y = Yellow

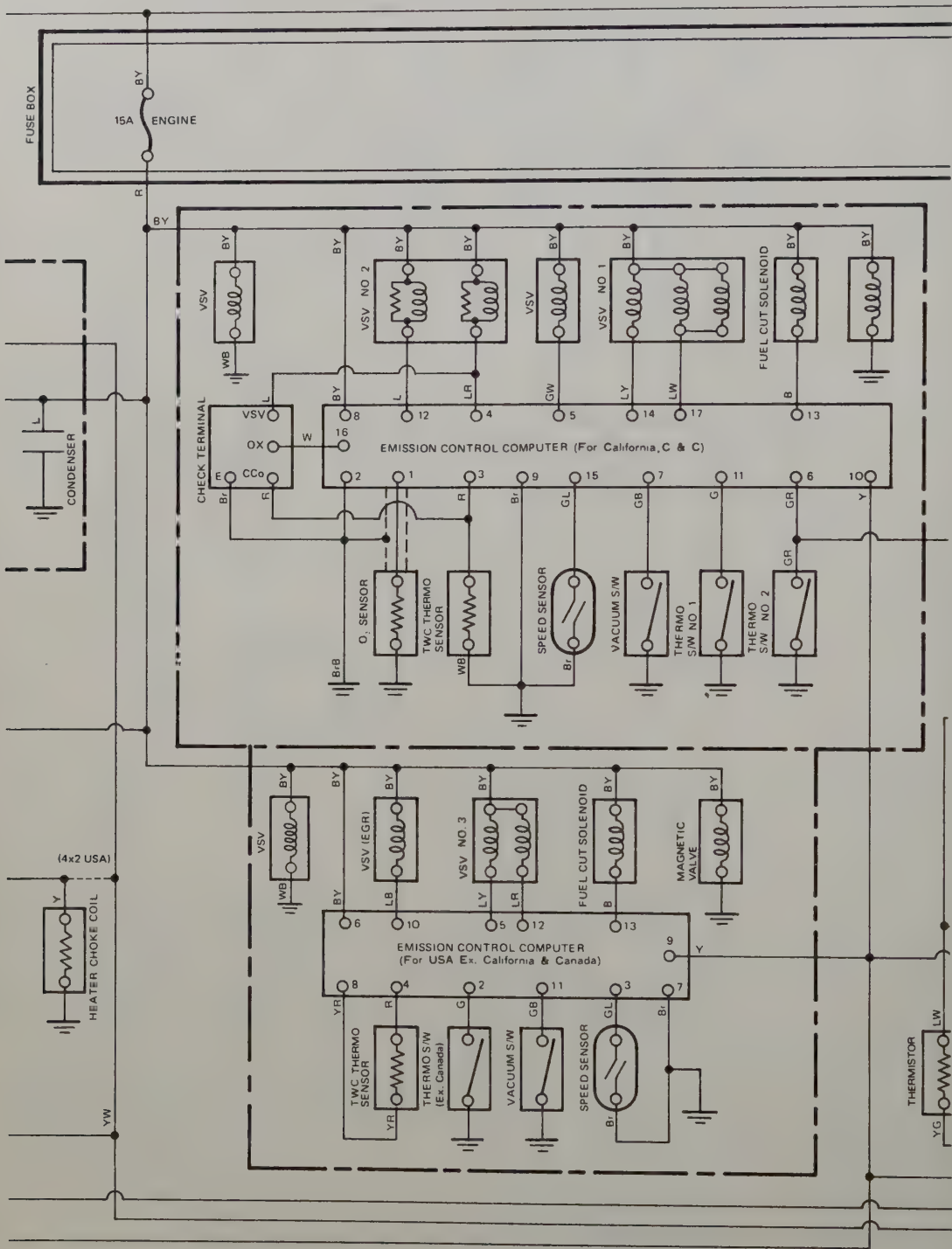
Example: RG, is for Red and a Green line.

PICKUP

00820-89146-J- ¹ / ₂	82210-89345
00820-89146-J- ² / ₂	82210-89346
00820-95111- ¹ / ₂	82210-89347
00820-95111- ² / ₂	82210-89348
82210-89339	82410-89180
82210-89340	82420-89181
82210-89341	82210-95147
82210-89342	82210-95148
82210-89343	82210-95149
82210-89344	82210-95150

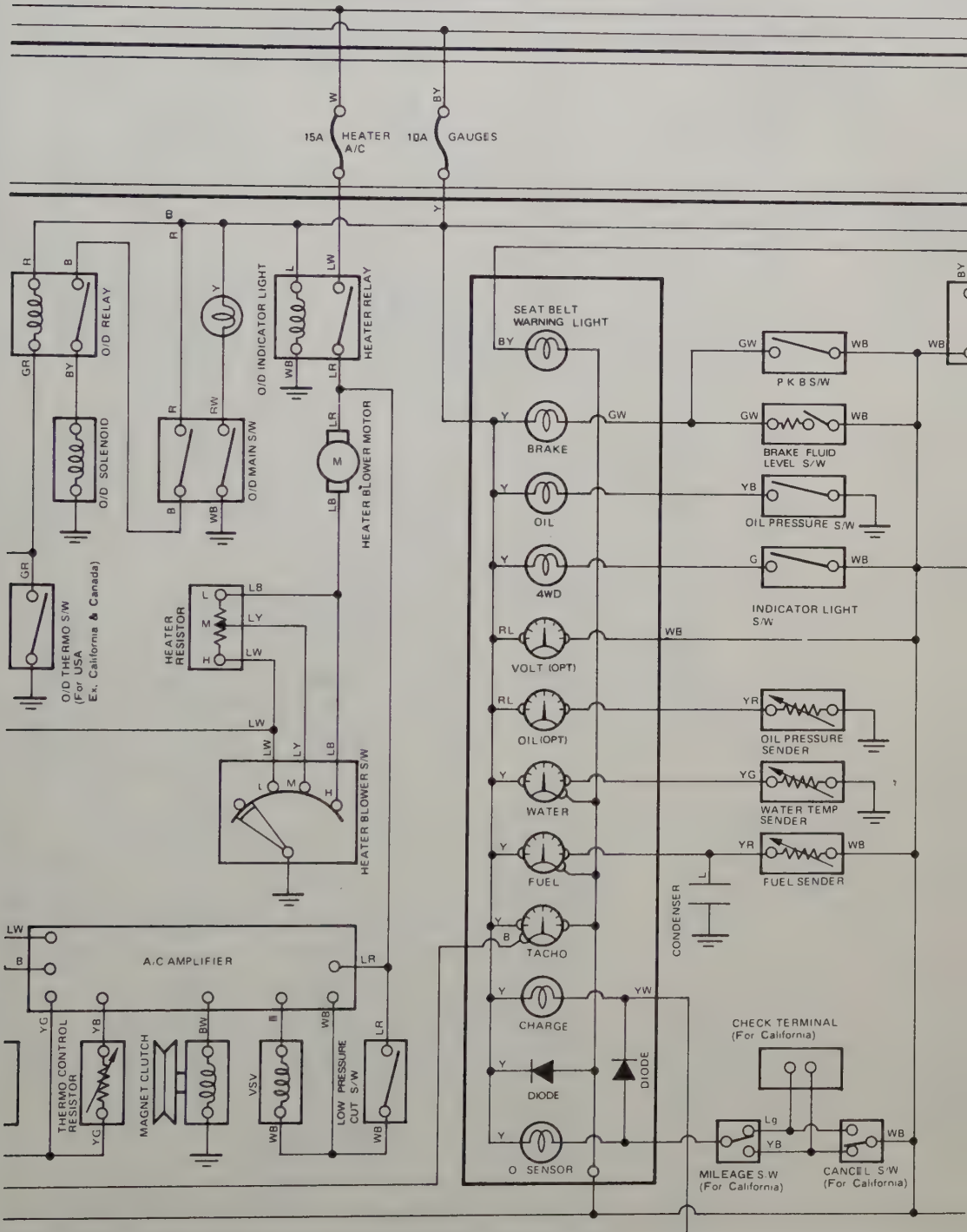
FIG. 1





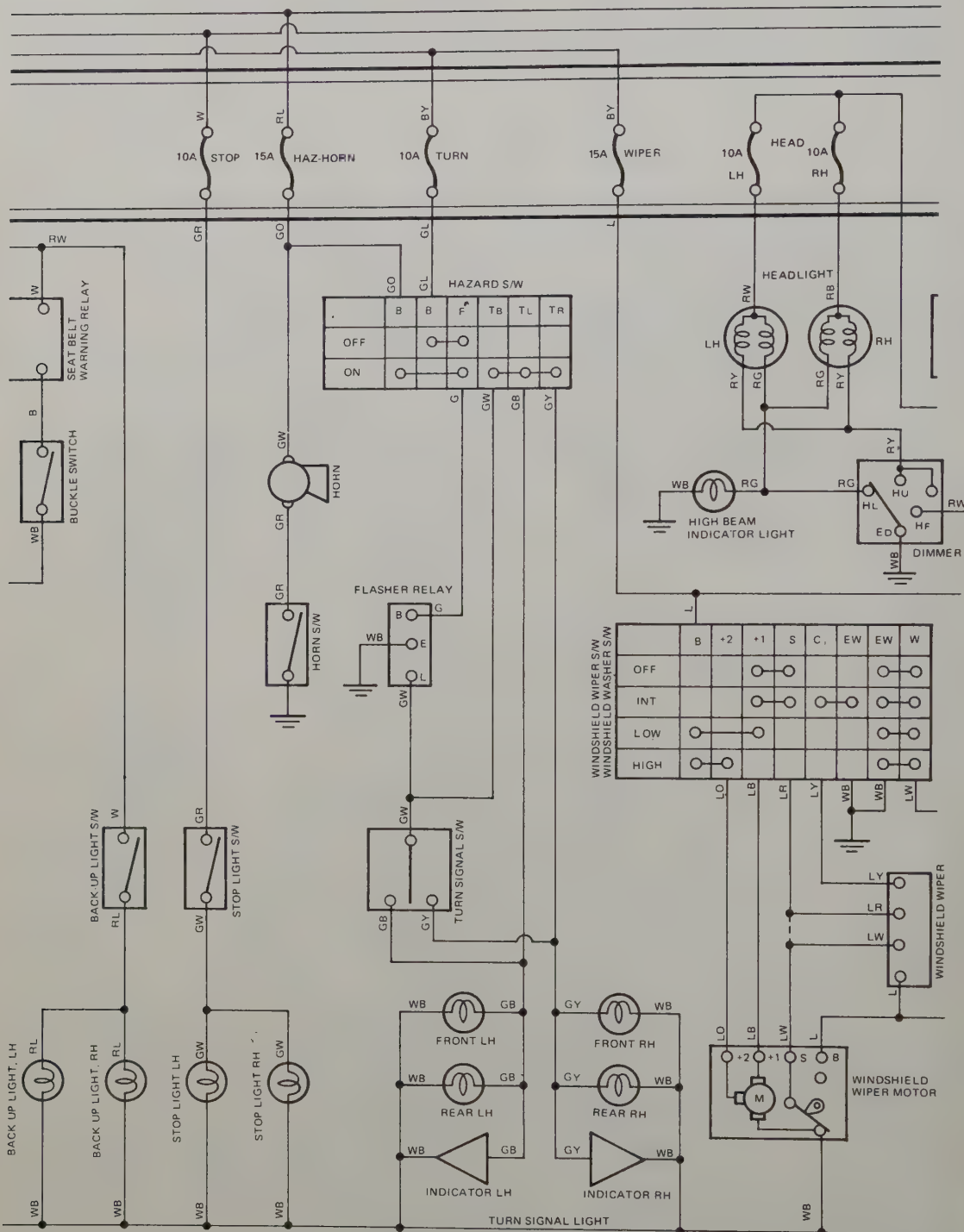
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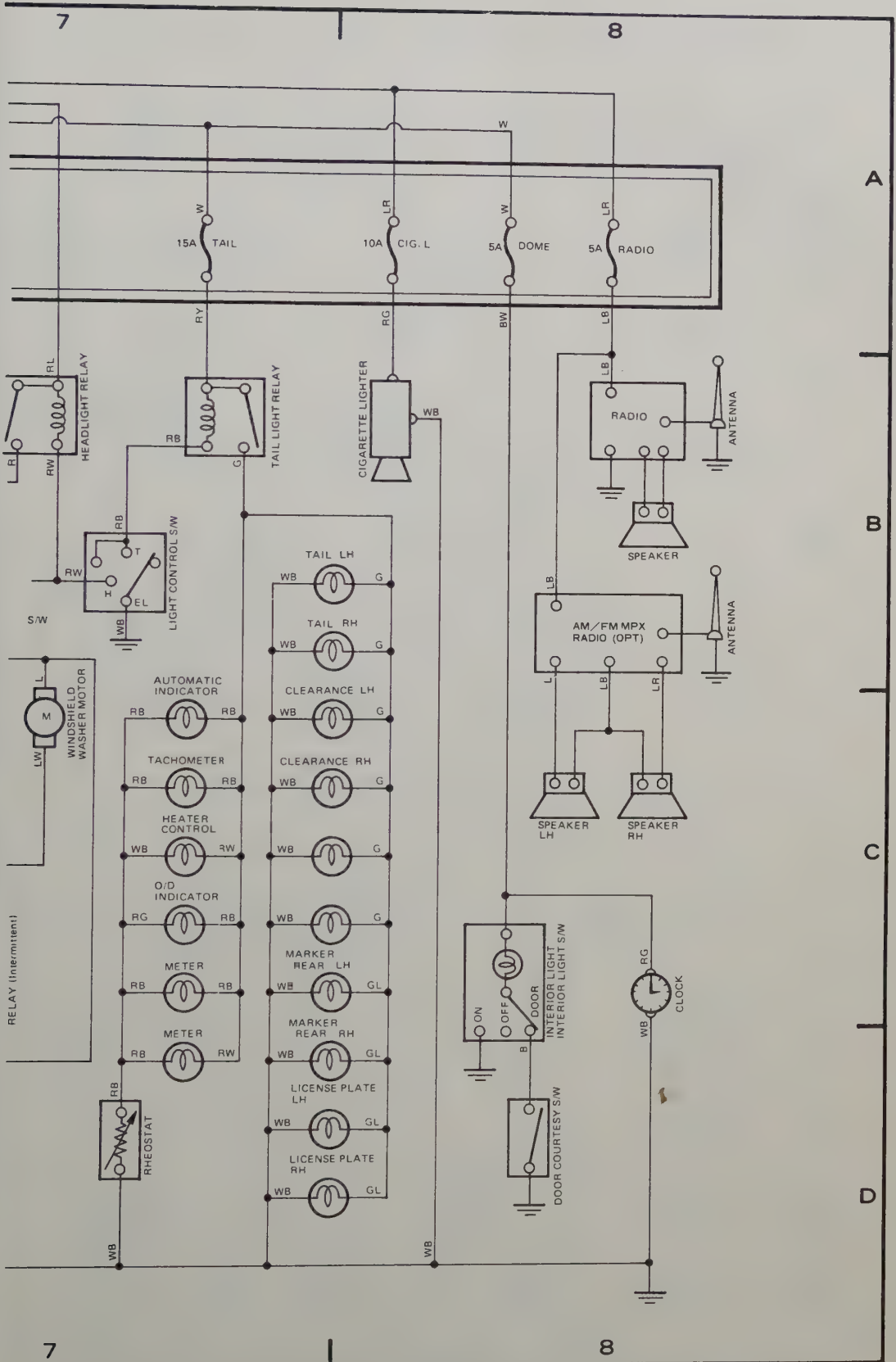
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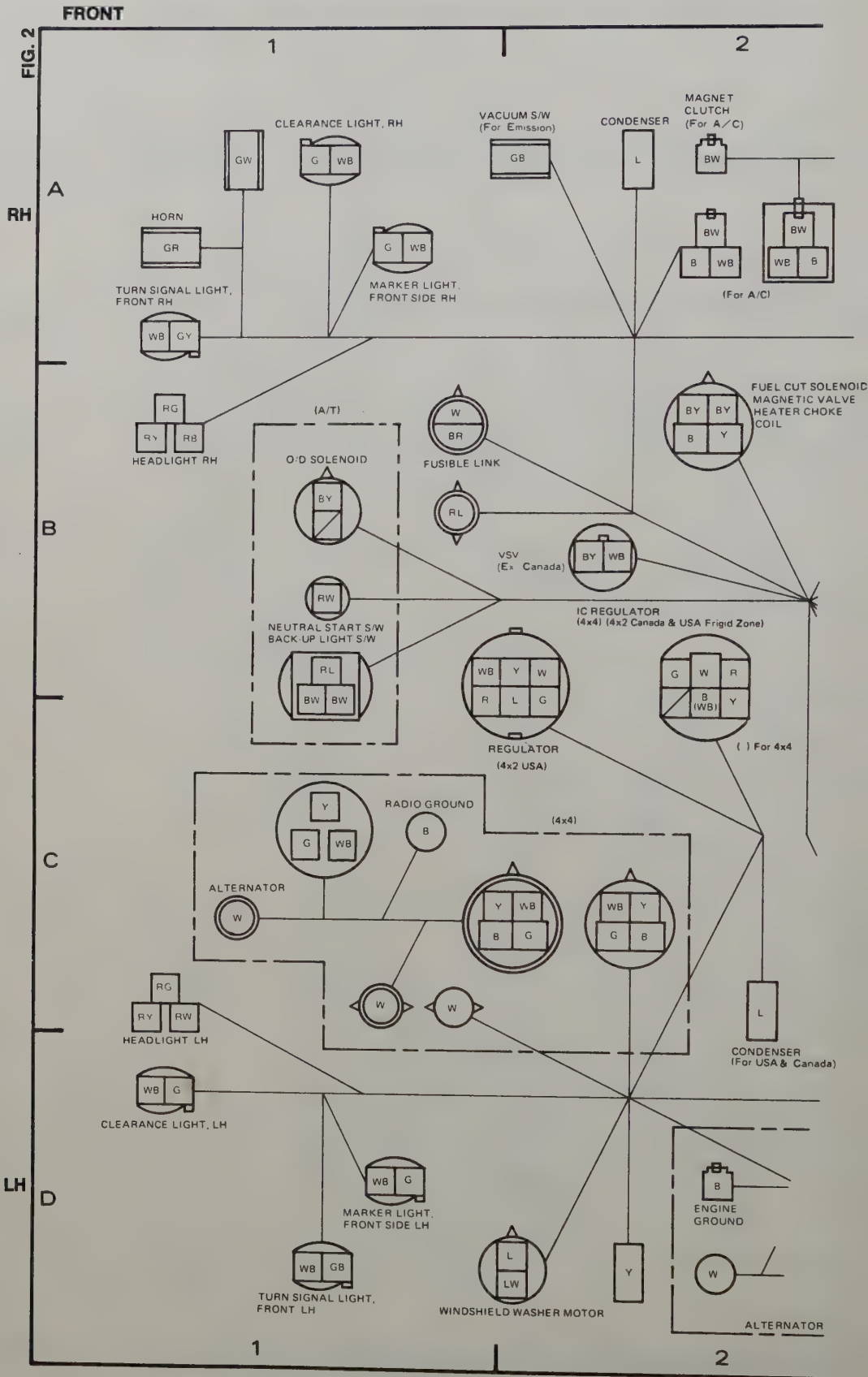


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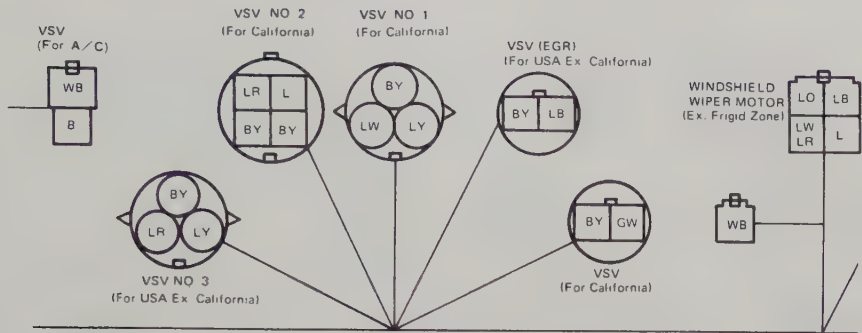




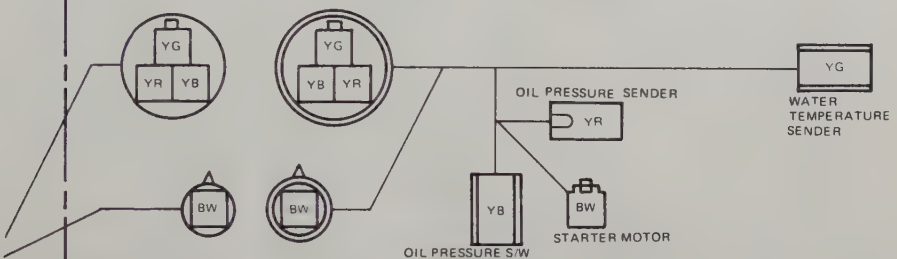


INSTRUMENT PANEL

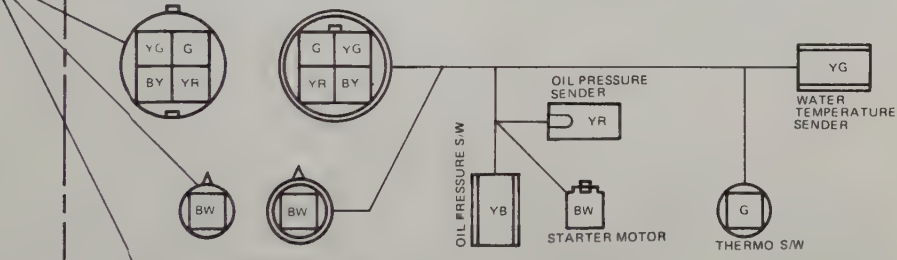
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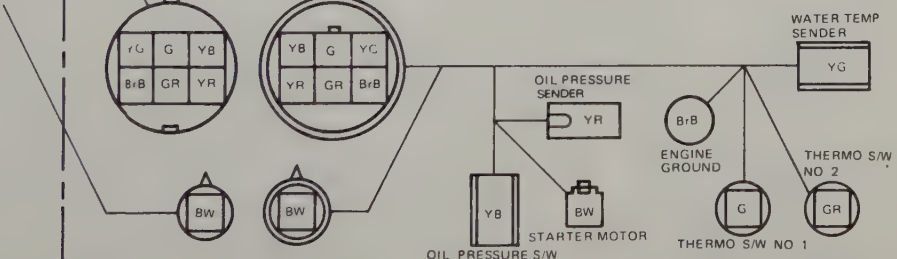
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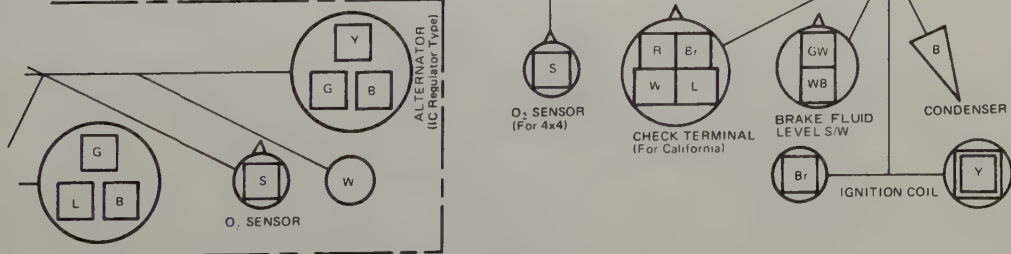
(For USA Ex California)



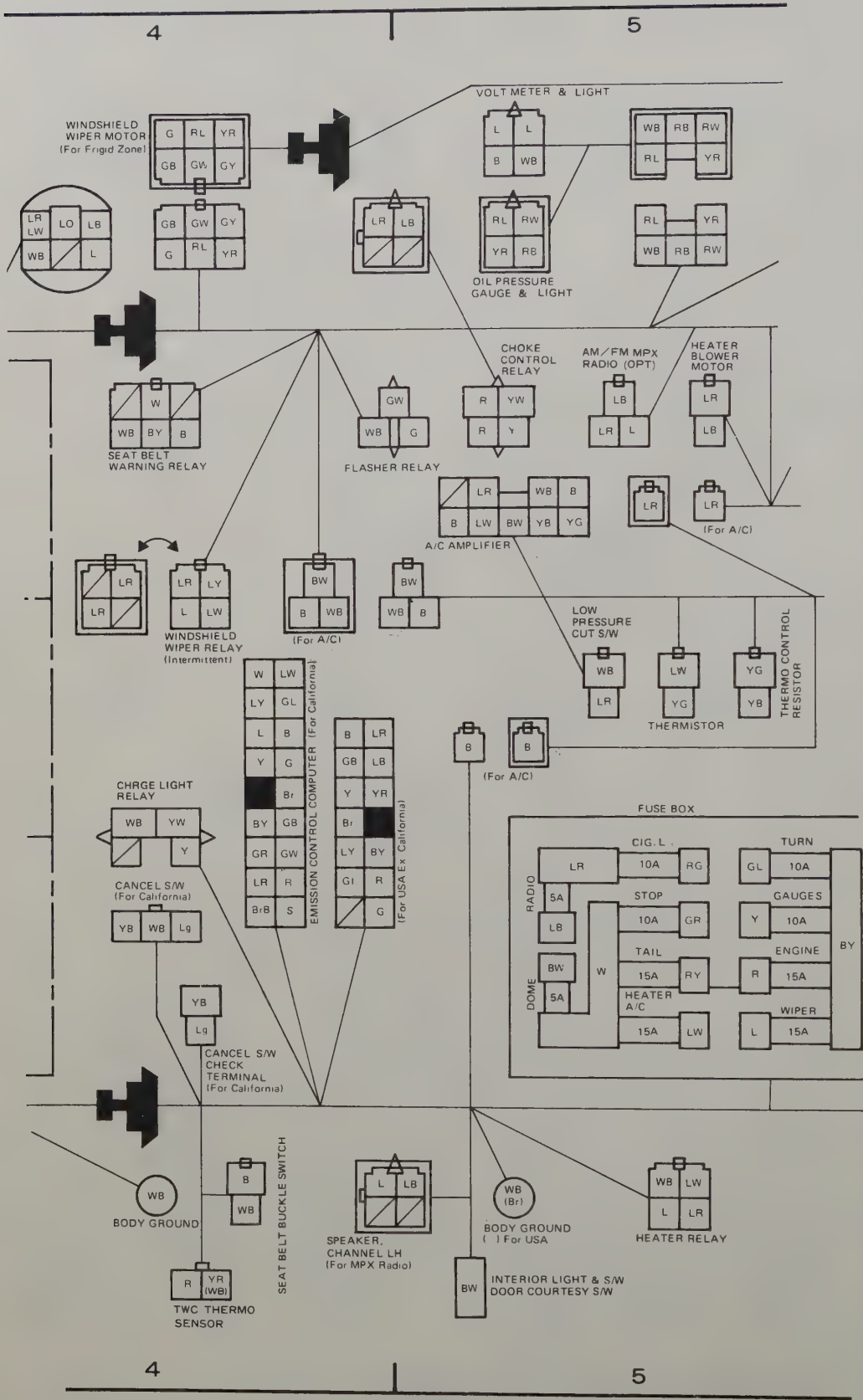
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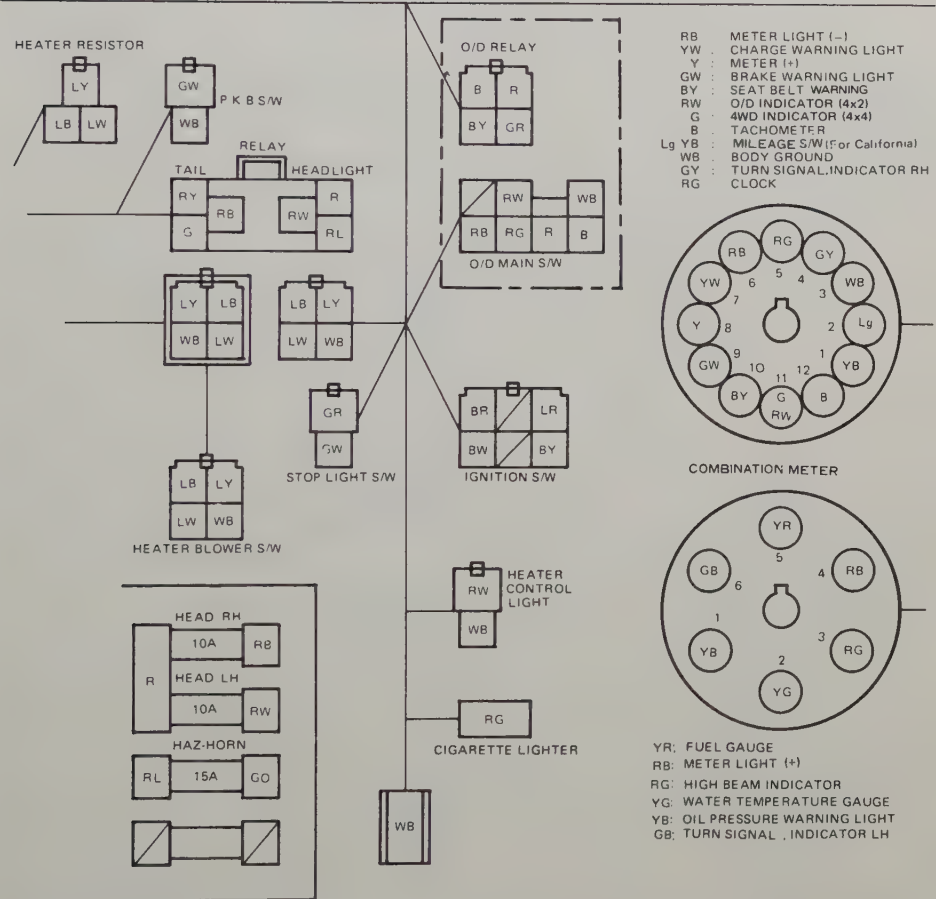
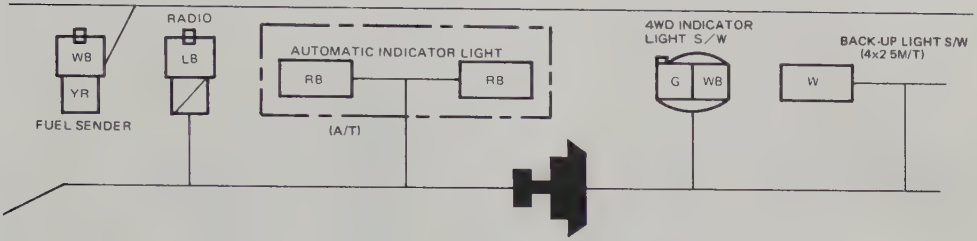
(4x2)



3



6



6

REAR

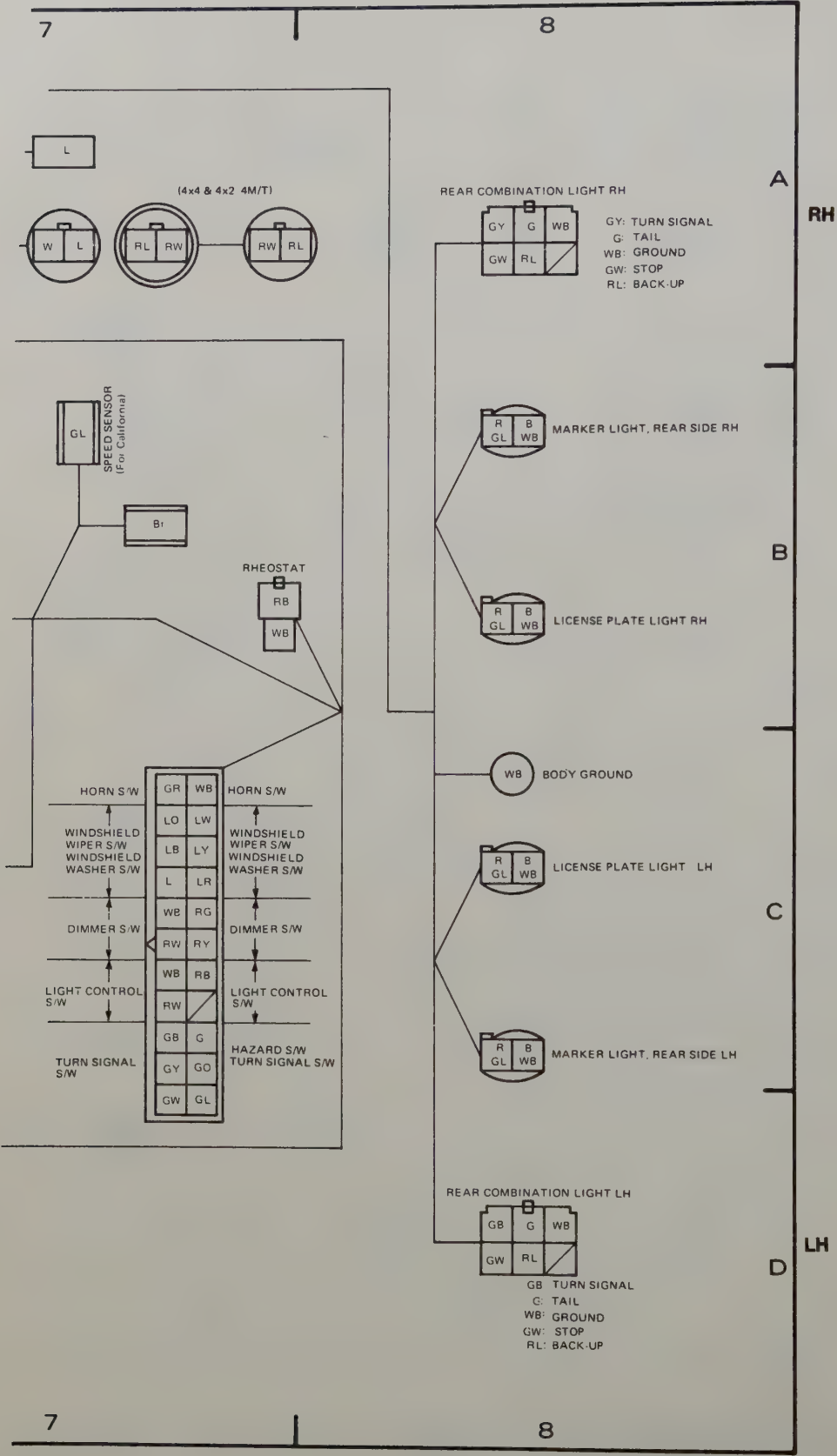
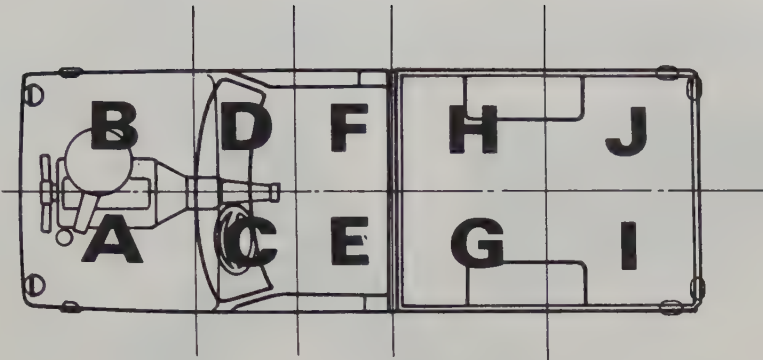


FIG. 3



Wiring color code is shown with alphabetical letter/s.
The first letter indicates the basic color for the wire.
and the second letter indicates the spiral line color.

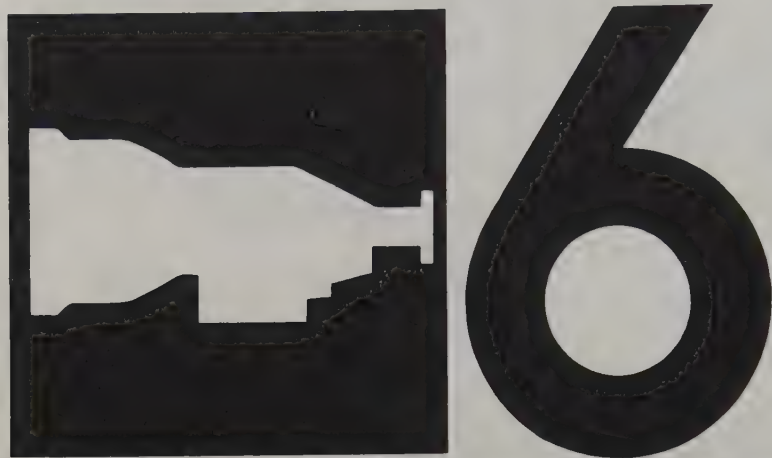
B = Black	O = Orange
Br = Brown	P = Pink
G = Green	R = Red
Gr = Grey	S = Shield Wire
L = Light Blue	W = White
Lg = Light Green	Y = Yellow

Example: RG, is for Red and a Green line.

PICKUP

00820-95112	82050-89102
00820-89148	82050-89103
82210-89377	82050-89104
82210-95158	82272-89101
82310-95110	82410-89189
82203-95112	82410-89190
82050-95110	82410-89185
82050-95111	82410-89186

Clutch and Transmission



MANUAL TRANSMISSION

Two manual transmissions are offered in the Toyota pick-up. One is a four speed which has been used without design change since 1970, although the internal ratios have been altered to suit the three different engines. The other is a five speed overdrive, first introduced in 1975. The transmissions share no parts. Both transmissions are fully synchronized in all forward gears, and use internal shifting linkages with no provision for external adjustment. For 1981 the SR-5 4 x 4 Models have a five speed overdrive transmission, replacing last years four speed. The five speed is optional on the 4 x 4 Long Bed Deluxe.

REMOVAL AND INSTALLATION

1. Remove the console box or floor mat, and remove the shift lever boot retainer. Raise the boot and remove the shift lever assembly using a pair of channel lock pliers as outlined in Chapter 3 under "Engine Removal and Installation."

2. Disconnect the negative battery cable.

3. Drain the coolant from the engine and disconnect the upper radiator hose.

4. On 8R-C and 18R-C engines, there is a bracket which supports the flexible line

from the clutch master cylinder to the slave cylinder. Unbolt the bracket from the engine.

CAUTION: *Do not separate the tubes; just remove the bracket.*

5. Disconnect the accelerator torque rod, which runs from the gas pedal to the carburetor, at the firewall.

6. Remove the starter upper mounting nut on 8R-C and 18R-C engines.

7. Jack up the truck and support it on jackstands.

8. On 8R-C and 18R-C engines, remove the starter lower mounting bolt and the starter wiring, and remove the starter. On 20Rs and 22Rs disconnect the starter wiring, remove the mounting nut and bolt, and remove the starter.

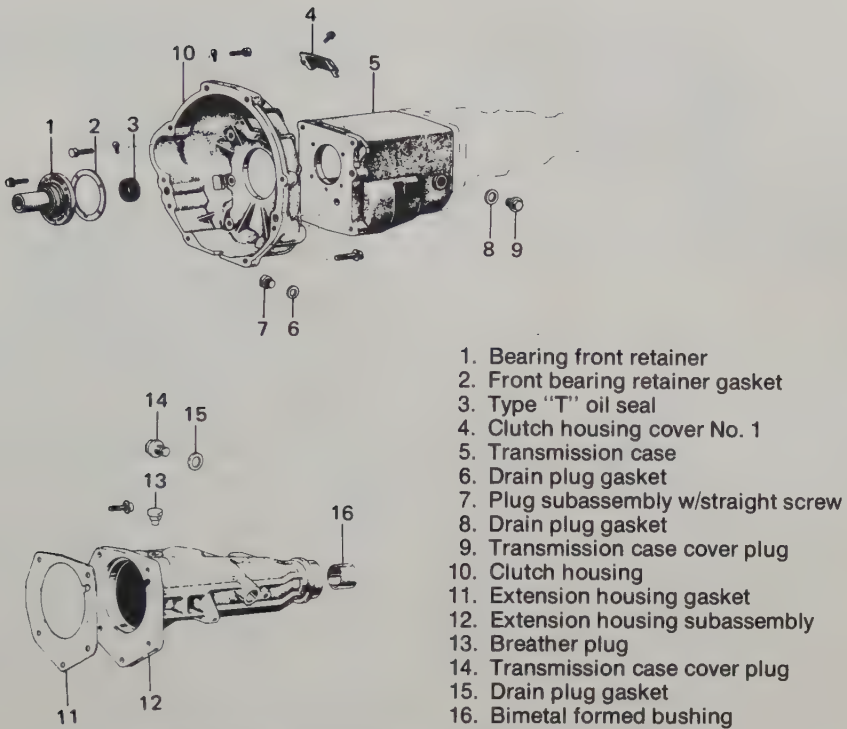
9. Remove the clamp holding the clutch slave cylinder in position.

CAUTION: *Do not disconnect the hydraulic line from the cylinder.*

10. Disconnect the exhaust pipe from the manifold flange, and remove the pipe clamp closest to the manifold. On 20Rs and 22Rs, also remove the heat insulator, transmission mounting bolts, and bracket on that side.

11. Disconnect the clutch slave cylinder to clutch fork link at the clutch fork.

12. Remove the parking brake cable from the lever. It is not necessary to remove the



The external components of the four speed transmission

entire equalizer assembly, as it will drop out of the way when the frame crossmember is removed.

13. Disconnect the speedometer cable.
14. Disconnect the back-up light wiring.
15. Matchmark the driveshaft flange and the transmission flange, then unbolt the driveshaft and move it out of the way. Plug the transmission output shaft opening to prevent oil leakage.

16. Support the transmission on a jack and remove the rear engine support/frame crossmember.

17. Loosen, but do not remove, the clutch housing-to-engine block bolts. Drop the

transmission down slightly and then remove the bolts completely. The transmission must be drawn to the rear of the truck while lowering so that it will clear the clutch assembly.

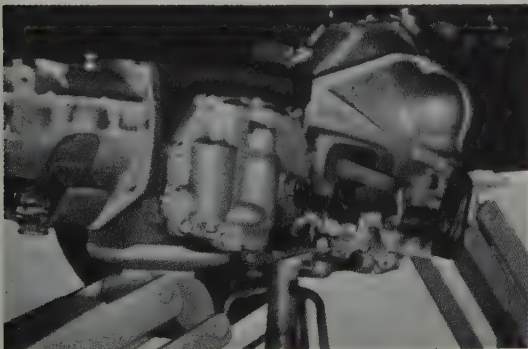
CAUTION: To prevent the oil pan from striking the suspension in 8R-C and 18R-Cs, and to prevent the EGR valve from striking the firewall on 20Rs, place a wood block under the oil pan and support it with a jack.

18. Before installing the transmission, apply a thin coating of multipurpose grease on the input shaft end and splines, the clutch release bearing, and the clutch diaphragm spring contact surfaces.

When installing the transmission, it is necessary to use an alignment tool to center the clutch disc. These are available at auto parts stores.

After aligning the clutch, insert the transmission input shaft, being certain that its splines are properly meshed with those on the clutch. Use a jack to support the transmission while aligning the mounting bolts of the clutch housing. Tighten the clutch housing-to-engine block bolts to 36–51 ft. lbs.

After installing all the components removed earlier, adjust the parking brake if necessary, and the clutch release fork end



Removing the transmission

play to 0.08–0.14 in. Apply gear oil to the shift lever ball, and multipurpose grease to the shift lever bushing. Be certain that the driveshaft matchmarks are aligned. Fill the engine cooling system and check the level of transmission oil before road testing the truck.

NOTE: If the clutch master cylinder hydraulic system has been separated at one of its connections, the system will have to be bled.

CLUTCH

The clutch is a single, dry disc type utilizing a diaphragm type pressure plate. Clutch release bearings are sealed ball bearing units which require no lubrication. These bearings should never be washed in any kind of solvent.

Clutch operation is hydraulic; the system consists of a master cylinder mounted in the engine compartment and a slave cylinder mounted on the clutch housing.

CLUTCH PEDAL HEIGHT ADJUSTMENT

NOTE: The total clutch free-play should be about 1½–2 in. when measured at the pedal. If excessive freeplay exists, check the clearance on all components rather than attempting to adjust all the excess out at one point.

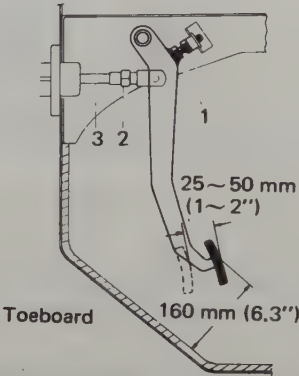
The pedal height from the floorboard to

the center of the clutch pedal should be 6¾ in. Adjust to this specification by turning the pedal stop bolt located above the pedal.

FREE-PLAY ADJUSTMENT

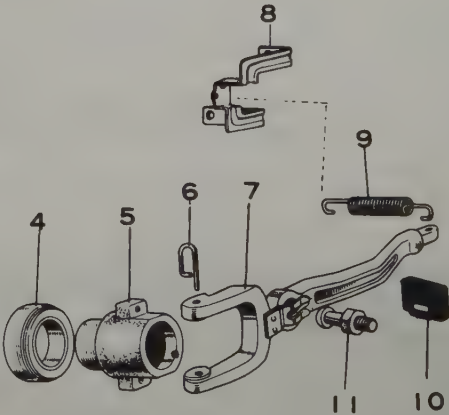
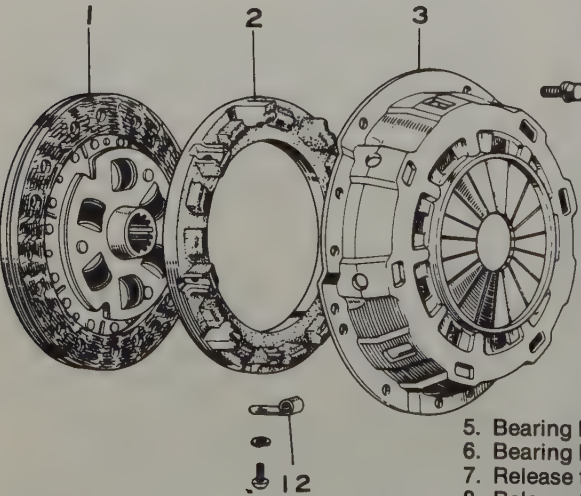
1. Adjust the clearance between the master cylinder pushrod and the master cylinder piston by loosening the locknut on the pushrod and turning the pushrod. The specified clearance is 0.02–0.12 in.

2. Adjust the play at the release fork tip by loosening the locknut on the release cylinder pushrod and turning the pushrod. There should be 0.08–0.14 in. clearance at the fork tip and a little better than one inch clearance when measured at the pedal.



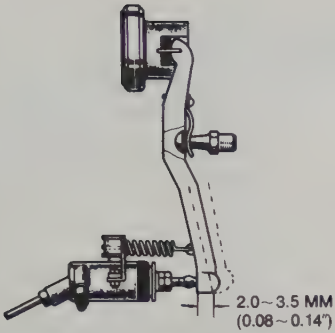
Clutch pedal adjustment

- 1. Clutch disc
- 2. Pressure plate
- 3. Clutch cover
- 4. Throwout bearing



- 5. Bearing hub
- 6. Bearing hub clip
- 7. Release fork
- 8. Release fork spring hanger
- 9. Release fork spring
- 10. Release fork boot
- 11. Release fork ball
- 12. Clutch retracting spring

Clutch components



Measuring the play at the release fork tip

REMOVAL AND INSTALLATION

1. Remove the transmission.
2. Stamp or chalk match marks onto the clutch cover and flywheel. They were balanced as an assembly at the factory, and should be assembled in their original position. Loosen the bolts retaining the clutch cover to the flywheel.

NOTE: Loosen all the bolts one turn at a time before removing any of them. In this way the pressure on the clutch disc is gradually released.

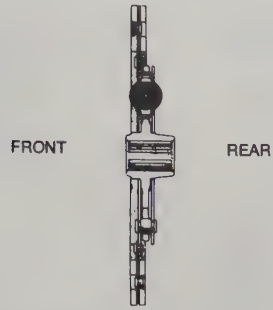
3. Remove the clutch cover bolts and remove the clutch.

4. Inspect the flywheel surface for cracks, warpage and oil. If the flywheel or clutch has oil on it this may indicate that the rear main bearing oil seal is leaking. If this is the case, consult Chapter 3 for the instructions needed to replace the seal.

5. When installing a new clutch be sure not to get grease on the disc or pressure plate surface. Align the match marks and install the clutch disc and clutch cover on the flywheel. Tighten the bolts slowly and in rotation so that the pressure is applied gradually to the disc.



Centering the clutch disc



Proper placement of the clutch disc

NOTE: The clutch disc must be positioned so that the short side of the splined section faces the flywheel.

6. After loosely installing the assembly you will have to align the clutch disc. This is done with an aligning tool, an old mainshaft from a transmission, or with the transmission itself although this may be quite difficult. With the alignment tool in position, fully tighten the bolts to about 16 ft. lbs.

Clutch Release Fork and Throwout Bearing

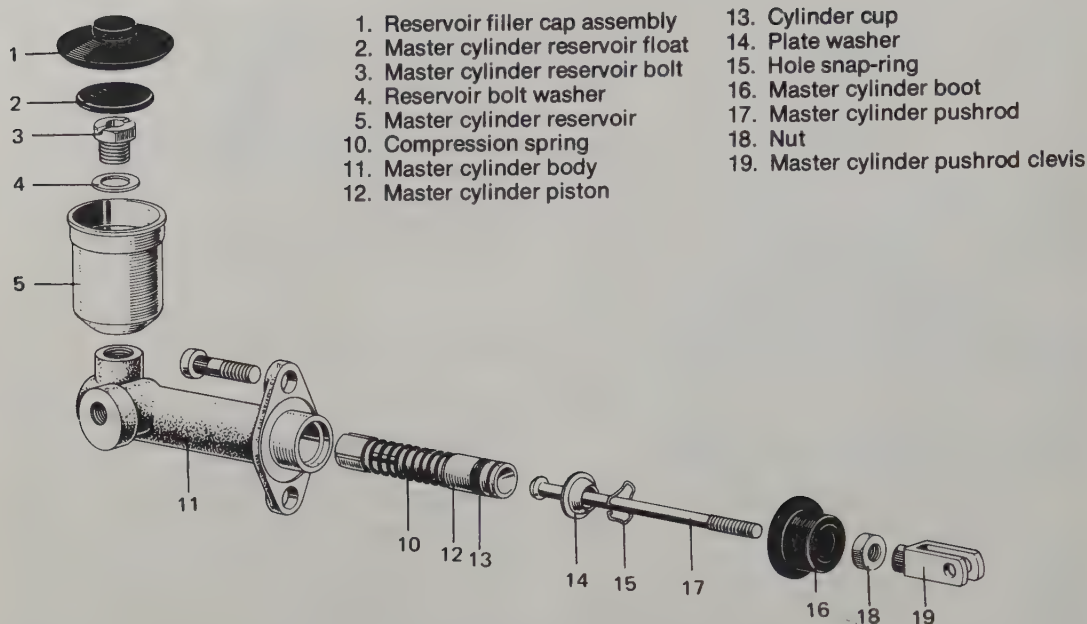
The throwout bearing and fork assembly extend through the clutch housing section of the transmission case. Whenever the clutch is replaced, it is a good policy to also replace the throwout bearing. This reduces the chance that the transmission will have to be removed a second time, after replacing the clutch, to replace the bearing. The throwout bearing is pressed onto the bearing hub. You will need a press or a vise to remove and replace it.

1. Pull the two hub clips from the release fork, and remove the bearing hub with the throwout bearing.



1. Release fork ball 2. Hub clip

Clutch release fork and bearing installed



Clutch master cylinder—exploded view

2. Press the old bearing off the bearing hub.

3. Press the new bearing onto the hub, being careful not to cock the bearing to one side. Press it on evenly and make certain that it is fully seated. The bearing is sealed at the factory and requires no additional lubrication.

4. Place the bearing hub assembly onto the release fork, and replace the two hub clips.

The release fork does not have to be removed to replace the throwout bearing. However, if removed, apply multipurpose grease liberally to the release fork ball before replacing the fork.

Clutch Master Cylinder

REMOVAL

1. Disconnect the master cylinder pushrod from the clutch pedal.

2. Remove the hydraulic line from the master cylinder being careful not to damage the compression fitting.

3. Remove the two bolts holding the master cylinder to the engine compartment.

CAUTION: Brake fluid dissolves paint. Do not allow it to drip onto the body when removing the master cylinder.

OVERHAUL

1. Disassemble the master cylinder by unscrewing the clutch pedal clevis from the pushrod. Also remove the locknut.

2. Pull off the rubber boot to expose an internal snap-ring. Remove the snap-ring and withdraw the piston and compression spring.

3. Take a clean rag and wipe out the inside of the cylinder. Inspect the inside of the cylinder for scoring and deposits. Use crocus cloth or a small hone to refinish the inside of the cylinder. If light honing will not remove score marks replace the cylinder.

CAUTION: Be careful not to remove too much from the cylinder walls as the cups will not be able to seal the cylinder if the diameter is enlarged excessively.

4. Wash all metal parts in solvent.

5. Further disassembly should be avoided unless the reservoir is leaking. If the reservoir needs to be replaced, remove the cap and remove the master cylinder reservoir bolt located at the bottom of the reservoir. Tighten the bolt to 14–22 ft. lbs. upon reassembly.

6. With new parts from a rebuilding kit assemble the master cylinder. Coat the cylinder wall with brake fluid so that the edges of the new cups will not be damaged.

7. Reinstall the master cylinder. Partially tighten the hydraulic line before tightening

the master cylinder mounting bolts. Adjust the pushrod-to-pedal clearance as outlined earlier, after bleeding the system.

Clutch Slave Cylinder

REMOVAL

1. Jack up the front of the truck and support it on jackstands.
2. Remove the tension spring on the clutch fork.
3. Remove the hydraulic line from the slave cylinder. Be careful not to damage the fitting.
4. Turn the release cylinder pushrod in sufficiently to gain clearance from the fork.
5. Remove the mounting bolts and withdraw the cylinder.

OVERHAUL

1. Remove the pushrod, rubber boot, piston and cups from the cylinder.
2. Clean the inside of the cylinder with a rag and inspect for scoring. If there is no serious damage, hone the cylinder just enough to remove deposits. Replace the cylinder if light honing does not remove the score marks. Wash all the parts in brake fluid before assembly.
3. Coat the new rubber parts in brake fluid and reassemble.

INSTALLATION

1. Install the hydraulic line from the master cylinder.
2. Position the cylinder on the clutch housing and install the clamp and retaining screws.
3. Adjust the clearance from the pushrod to the fork tip to 0.08–.14 inches.

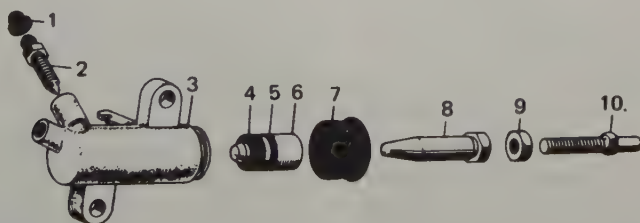
NOTE: *The system must be bled after the cylinder is reinstalled.*

BLEEDING

NOTE: *This procedure may be utilized when either the clutch master or slave cylinder has been removed or if any of the hydraulic lines have been disturbed.*

CAUTION: *Do not spill brake fluid on the body of the vehicle as it will destroy the paint.*

1. Fill the master cylinder reservoir with brake fluid.
2. Remove the cap and loosen the bleeder screw on the clutch slave cylinder. Cover the hole with your finger.
3. Have an assistant pump the clutch pedal several times. Take your finger off the hole while the pedal is being depressed so that the air in the system can be released. Put your finger back on the hole and release the pedal.
4. After fluid pressure can be felt (with your finger) tighten the bleeder screw.
5. Put a short length of hose over the bleeder screw and place the other end into a jar half full of clean brake fluid.
6. Depress the clutch pedal and loosen the bleeder screw. Allow the fluid to flow into the jar.
7. Tighten the plug and then release the clutch pedal.
8. Repeat Steps 6 and 7 until no air bubbles are visible in the bleeder tube.
9. When there are no more air bubbles in the system, tighten the plug fully with the pedal depressed. Replace the plastic cap.
10. Fill the master cylinder to the correct level with brake fluid.
11. Check the system for leaks.



1. Bleeder plug cap
2. Bleeder plug
3. Slave cylinder body
4. Cylinder cup
5. Cylinder cup

6. Slave cylinder piston
7. Slave cylinder boot
8. Slave cylinder pushrod No. 1
9. Nut
10. Slave cylinder pushrod No. 2

Clutch slave cylinder disassembled

AUTOMATIC TRANSMISSION

The A-30 Toyoglide used from 1972 to 1977 is a fully automatic three-speed transmission designed by Toyota originally for use in their Crown and Mark II passenger cars.

The power transmission is achieved through a torque converter, planetary gear set, multiple disc clutches and front and rear bands. Automatic shifting is controlled by road speed, engine vacuum, and a mechanical connection from the accelerator pedal to the transmission.

In 1978 Toyota discontinued the use of the Toyoglide A-30 transmission, substituting instead the A-40. The A-40 has no bands, and therefore no internal adjustments. Two clutches and three multi-disc brakes actuate planetary gears to change speeds.

The easiest way to differentiate the two transmissions is by the shape of the fluid pans. A-30 transmissions have a large X stamped in the bottom of the pan, while the A-40 pan is flat. In addition, the A-30 drain plug is located in the right front corner; the A-40 drain plug is at the center rear. For 1981 a four speed overdrive automatic transmission is available on 4 x 2 SR-5 Models and California Deluxe Long Bed models.

It is unlikely that you will ever disassemble the transmission yourself. There are, however, many service operations which can be performed easily and will extend the life and performance of the transmission.

PAN REMOVAL AND INSTALLATION

1. Jack up the front end of the vehicle and support it on jackstands.
2. Place a container under the transmission drain plug and drain the transmission fluid.
3. Remove the pan securing bolts and remove the pan and gasket.
4. The pan may be washed in solvent for cleaning but must be absolutely dry when it is reinstalled. Do not wipe it out with a rag, or you will risk leaving bits of lint inside the transmission.
5. Remove all traces of the old gasket from the pan and from the transmission. Install a new gasket on the pan using small quantities of sealer around the bolt holes.
6. Install the pan, tightening the securing bolts to 11–14 ft. lbs.

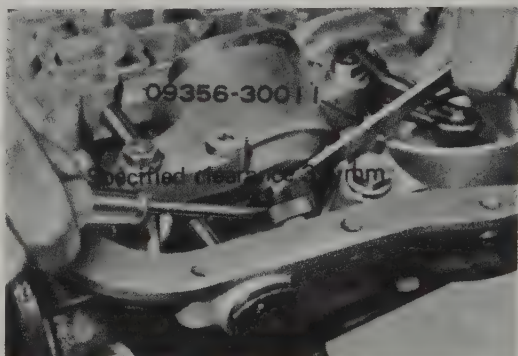
CAUTION: *The pan bolts break easily if overtightened.*

7. Fill the transmission to the correct level with the specified fluid.

FRONT BAND ADJUSTMENT

This adjustment is necessary only on the A-30 transmission, used from 1972–77.

1. Remove the pan.
2. Pry the band engagement lever toward the band with a screwdriver.
3. The gap between the end of the piston rod and the engagement bolt should be 0.118 in.
4. Turn the engagement bolt until the proper clearance is obtained.
5. Install the pan and refill the transmission.



Adjusting the front band

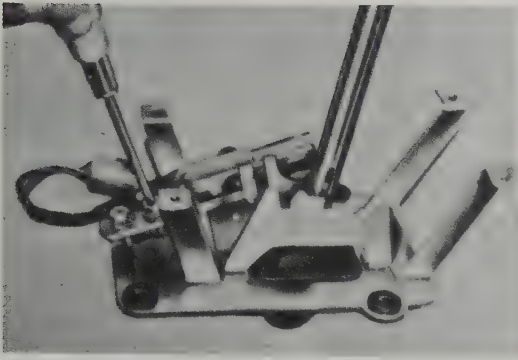
REAR BAND ADJUSTMENT

The rear band adjusting bolt is located on the outside of the transmission case so that it is not necessary to remove the pan in order to perform the adjustment. This adjustment is not necessary on the A-40.

1. Loosen the adjusting bolt locknut and turn the screw all the way in.
2. Back off the adjusting screw one full turn.
3. Lock the adjustment by tightening the adjusting screw locknut.

NEUTRAL SAFETY SWITCH ADJUSTMENT

1. Remove the screws which hold the center console in place.
2. Remove the electrical connector and remove the console from the vehicle.
3. Loosen the switch securing bolts.
4. Set the selector in the Drive position.
5. Move the switch so that the arm just contacts the control shaft lever.
6. Tighten the switch retaining bolts.



Neutral safety switch adjustment

7. Check the operation of the switch; the truck should start only in Neutral or in Park. The back-up lamps should only operate in the Reverse position.

8. If the switch cannot be adjusted so that it functions properly, replace it with a new one.

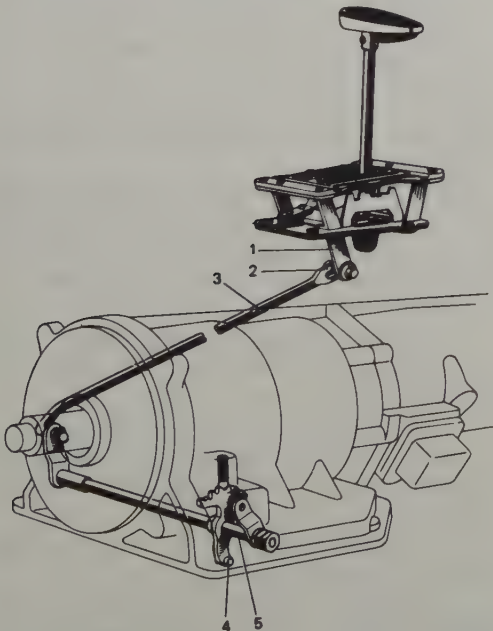
9. Reinstall the console.

SHIFT LINKAGE ADJUSTMENT

1. Check all of the shift linkage bushings for wear. Replace any that are excessively worn.

2. Set the manual valve lever on the transmission in the Neutral position.

3. Lock the connecting rod swivel with



- | | |
|------------------------|-----------------------|
| 1. Gear selector lever | 4. Manual valve lever |
| 2. Intermediate rod | 5. Shaft |
| 3. Control rod | |

Floorshift linkage for the automatic transmission

the locknut so that the pointer, selector, and manual valve lever are all in the Neutral position.

4. Check the operation by moving the selector through all the gears.

THROTTLE LINKAGE ADJUSTMENT

1972-77

When the carburetor throttle is wide open, the throttle linkage pointer should line up with the mark stamped on the transmission case. To adjust:

1. Loosen the locknuts on either end of the linkage adjusting turnbuckle located midway between the carburetor and the transmission.

2. Detach the throttle linkage connecting rod from the carburetor.

3. Align the pointer on the throttle valve lever with the mark stamped on the transmission case.

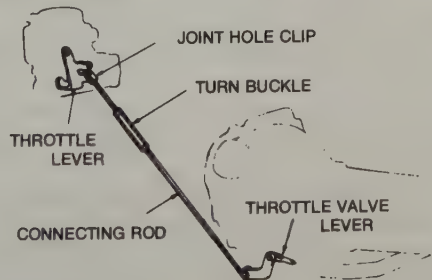
4. Rotate the turnbuckle so that the end of the throttle linkage rod and the carburetor throttle lever are aligned.

NOTE: *The throttle valve of the carburetor must be fully open during this adjustment.*

5. Tighten the turnbuckle locknuts and connect the throttle rod to the carburetor.

6. Open the throttle valve and check to see that the pointer and the mark are aligned on the transmission.

7. Road-test the truck. If the transmission keeps shifting rapidly back and forth between gears at certain speeds or if it fails to down-shift properly when going up hills, repeat the throttle linkage adjustment.



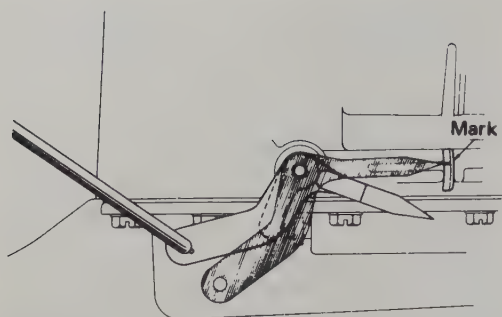
Throttle linkage

THROTTLE CABLE ADJUSTMENT

1. Remove the air cleaner assembly.

2. Push the accelerator to the floor and check that the throttle opens fully. If not, adjust the link so that it does.

3. Push back the rubber boot from the



Alignment marks on the transmission case and throttle lever

throttle cable which runs down to the transmission. Loosen the throttle cable adjustment nuts so that the cable housing can be adjusted.

4. Fully open the carburetor throttle by having an assistant press the accelerator all the way to the floor.

5. Adjust the cable housing so that, with the throttle wide open, the distance between the outer cable end rubber cap to the inner cable stopper is 2.05 in.

6. Tighten the nuts and double check the adjustment. Install the rubber boot and the air cleaner.

NOTE: 1979 and later distance is 0–0.04 in.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.
2. Drain the engine coolant and disconnect the upper radiator hose.

3. Disconnect the transmission throttle linkage at the carburetor.

4. On 8R-C and 18R-Cs, remove the upper mounting nut from the starter.

5. Raise the truck and support it with jackstands.

6. Working under the truck, drain the transmission fluid, then replace the drain plug.

7. Remove the starter wiring. On 8R-C and 18R-Cs, remove the lower bolt and remove the starter. On 20Rs, and 22Rs, remove the mounting nut and bolt, and remove the starter.

8. Remove the exhaust pipe from the exhaust manifold flange, and remove the exhaust pipe clamp.

9. Disconnect the connecting rod from the driver's side of the transmission.

10. Disconnect the speedometer cable.

11. Disconnect the parking brake cable from the lever.

12. Unbolt the driveshaft and tie it out of the way. Plug the transmission output opening.

13. Place a wooden block under the fluid pan as a buffer, and support the transmission with a jack.

14. Place a wooden block under the engine oil pan, and support the engine with a jack.

15. Remove the rear engine support/frame crossmember.

16. Slightly lower the transmission jack, and remove and plug the two fluid cooler tubes which run forward to the radiator.

17. Remove the bolts securing the transmission to the engine, and pull the transmission carefully to the rear.

CAUTION: *The torque converter will remain attached to the engine flywheel. Some fluid will drip from it; if possible, place a pan underneath.*

Toyota says that whenever the transmission is removed, the torque converter and the flywheel must be checked with a dial indicator for runout to prevent fluid leaks from the front seal of the transmission.

1. With the torque converter attached to the flywheel, measure the extension sleeve runout while rotating the crankshaft slowly. It must measure less than 0.0079 in.

2. If the runout exceeds the limit, remove the torque converter and measure the flywheel runout. It must measure less than 0.0047 in. (0.012 in. on A-40s).

3. Apply a coat of multipurpose grease to the torque converter shaft and the flywheel ring gear.

4. Assemble the torque converter into the transmission, so that its output shaft and the transmission input shaft are aligned. Rotate the torque converter until the dowel pin is at the bottom.

5. Install a guide pin into the bottom bolt hole next to the dowel pin. Align the flywheel and the torque converter.

6. Tighten the torque converter bolts to 11–16 ft. lbs. Rotate the crankshaft half a turn to reach all the bolts, and tighten them evenly.

7. Bolt the transmission to the engine. Tighten the bolts to 37–51 ft. lbs.

8. Replace the frame crossmember and the driveshaft. Attach the parking brake cable.

9. Replace the starter and its wiring. Attach the transmission cooler lines. Attach the speedometer cable.

10. Replace the exhaust pipe clamp and bolt the exhaust pipe to the manifold.

11. Install and adjust the throttle linkage rod. Attach the connecting rod to the transmission and adjust the shift lever linkage.

12. Connect the radiator hose and fill the engine with coolant. Fill the transmission with Type F fluid. If the torque converter was completely drained, the transmission will need about 7 quarts of fluid.

13. Connect the positive battery cable. Road test and check for leaks.

Transfer Case

REMOVAL AND INSTALLATION

1. Disconnect the negative battery terminal.

2. Jack up the truck supporting it by jackstands placed on the front rear housing. Use the same procedure for the rear.

3. Remove the rubber boot from the gear shift lever and transfer case. Using a pair of channel lock pliers push down and turn at the same time to remove the gear shift lever. Remove the transfer case lever by using a pair of snap ring pliers to remove the ring.

4. Remove the front propeller shaft.

NOTE: Before removing the bolts in this

shaft mark each flange for proper alignment during assembly.

5. Remove back-up light wiring.

6. Remove 4 Wheel Drive Light indicator wire.

7. Remove speedometer cable.

8. Remove clutch cylinder but do not break the line as it is not necessary.

9. Remove the starter.

10. Remove the exhaust pipe clamp.

11. Remove the bolts holding the bell housing to the engine.

NOTE: Before attempting to remove the rear cross member support the transmission with a jack.

12. Remove the rear cross member.

13. Support the engine with a wooden block and jack in the oil pan area.

14. Release the tension on the transmission jack and at the same time pull backwards on the transmission. You may have to lower the jack holding the engine to allow the transmission to come out of the clutch assembly.

15. Move the transmission from underneath the truck.

NOTE: Using this procedure may necessitate having a helper.

16. If you intend to disassemble the transfer case drain the oil at this time.

17. Installation is the reversal of removal.

Drive Train



DRIVELINE

Driveshaft and U-Joints

REMOVAL AND INSTALLATION

Standard Bed

1. Jack up the rear of the truck and support the rear axle housing with jackstands.
2. Paint a mating mark on the two halves of the rear universal joint flange.
3. Remove the bolts which hold the rear flange together.
4. Remove the splined end of the driveshaft from the transmission.

NOTE: *If you don't want to lose a lot of gear oil, plug the end of the transmission with a rag.*

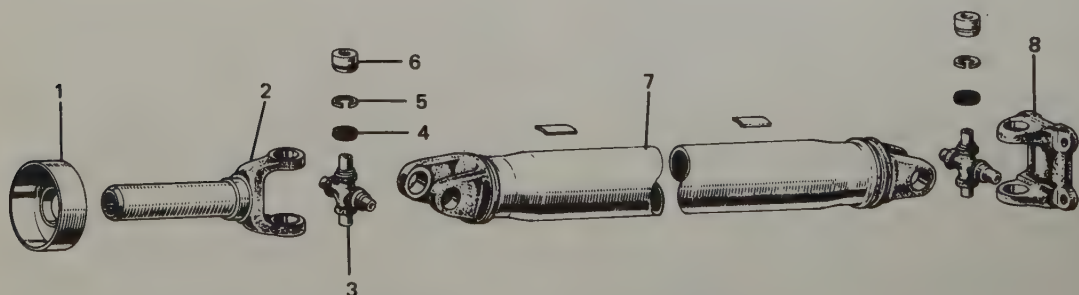
5. Remove the driveshaft from under the truck.

Installation is performed in the following sequence:

1. Apply multipurpose grease to the splined end of the shaft.
2. Insert the driveshaft sleeve into the transmission.

NOTE: *Be careful not to damage the extension housing grease seal.*

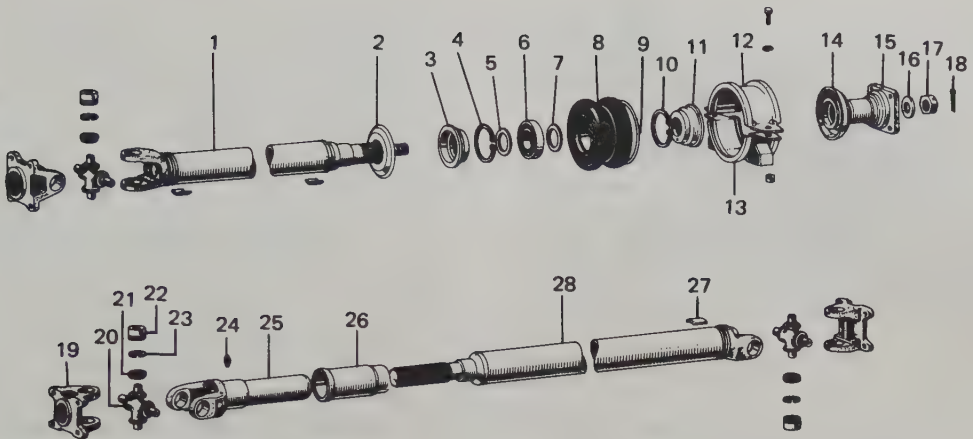
3. Align the mating marks on the rear



1. Sliding shaft dust cover
2. Universal joint yoke sleeve
3. Universal joint spider
4. Spider bearing seal

5. Snap-ring
6. Spider bearing
7. Driveshaft
8. Universal joint yoke flange

Components of the one-piece driveshaft used in the standard bed models



- | | | |
|-----------------------------------|--|---|
| 1. Intermediate driveshaft | 12. Center support bearing housing No. 1 | 21. Universal joint spider bearing seal |
| 2. Dust deflector No. 1 | 13. Center support bearing housing No. 2 | 22. Universal joint spider bearing |
| 3. Dust deflector No. 2 | 14. Dust deflector No. 1 | 23. Hole snap-ring |
| 4. Hole snap-ring | 15. Universal joint flange | 24. Grease fitting |
| 5. Dust deflector No. 3 | 16. Plate washer | 25. Universal joint sleeve yoke |
| 6. Radial ball bearing | 17. Castle nut | 26. Sliding shaft dust cover |
| 7. Dust deflector No. 4 | 18. Cotter pin | 27. Balance piece |
| 8. Center support bearing cushion | 19. Universal joint flange yoke | 28. Driveshaft |
| 9. Set ring | 20. Universal joint spider | |
| 10. Hole snap-ring | | |
| 11. Dust deflector No. 2 | | |

Two-piece driveshaft used in the long bed truck

flange and replace the bolts. Tighten to 22–36 ft. lb.

4. Remove the jackstands and lower the vehicle.

Long Bed

1. Jack up the rear of the truck and support the rear axle housing on jackstands.

2. Before you begin to disassemble the driveshaft components, you must first paint accurate alignment marks on the mating flanges. Do this on the rear universal joint flange, the center flange, and on the transmission flange.

3. Remove the bolts attaching the rear

universal joint flange to the drive pinion flange.

4. Drop the rear section of the shaft slightly and pull the unit out of the center bearing sleeve yoke.

5. Remove the center bearing support from the crossmember.

6. Separate the transmission output flange and remove the front half of the driveshaft together with the center bearing assembly.

To install proceed in this manner:

1. Connect the output flange of the transmission to the flange on the front half of the shaft.

2. Install the center bearing support to the crossmember, but do not fully tighten the bolts.

3. Install the rear section of the shaft making sure that all mating marks are aligned.

4. Tighten all flange bolts to 22–36 ft. lbs.

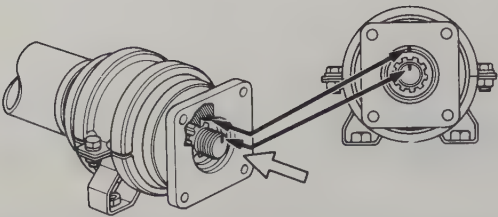
CENTER BEARING REPLACEMENT

The center support bearing is a sealed unit which requires no periodic maintenance. The following procedure should be used if it should become necessary to replace the bearing.

1. Remove the intermediate driveshaft and the center support bearing assembly.



Removing the driveshaft



Make the same aligning mark on the propeller intermediate shaft as the flange on disassembly

- 2. Paint mating marks on the universal joint flange and the intermediate driveshaft.
- 3. Remove the cotter pin and castle nut from the intermediate driveshaft. Remove the universal joint flange from the driveshaft using a press.
- 4. Remove the center support bearing assembly from the driveshaft.
- 5. Remove the two bolts from the bearing housing and remove the housing.
- 6. Remove the dust defectors (type #2) from both sides of the bearing cushion. Remove the dust defectors type #3 and #4 from either side of the bearing.
- 7. Remove the snap rings from each side of the bearing. This is easy to do if you have a snap ring tool which fits the holes in the ring, and very difficult otherwise. Remove the bearing.

To assemble:

- 1. Install the new bearing into the cushion and fit a snap ring on each side.
- 2. Apply a coat of multipurpose grease to the dust defectors type #3 and #4, and put them in their respective places on each side

of the bearing. Type #4, which has a slightly larger outside diameter, goes on the rear of the bearing.

3. Press the type #2 dust defectors onto each side of the cushion. The water drain holes in the defectors should be in the same position on each side of the cushion.

4. Assemble the two halves of the housing around the cushion. The water drain holes should face the bottom of the housing.

5. Press the support bearing assembly firmly onto the intermediate driveshaft, with the #3 type seal facing the front.

6. Match the mating marks painted earlier, and install the universal joint flange to the driveshaft. Tighten the castle nut to about 130 ft. lbs., and use a new cotter pin to lock it in place. Tighten the nut to align the holes for the cotter pin, but do not loosen it. It is okay to tighten it up to 150 ft. lbs.

NOTE: Check to see if the center support bearing assembly will rotate smoothly around the driveshaft.

7. When reinstalling the driveshaft, be certain to match up the marks on both the front transmission flange and the flange on the sleeve yoke of the rear driveshaft.

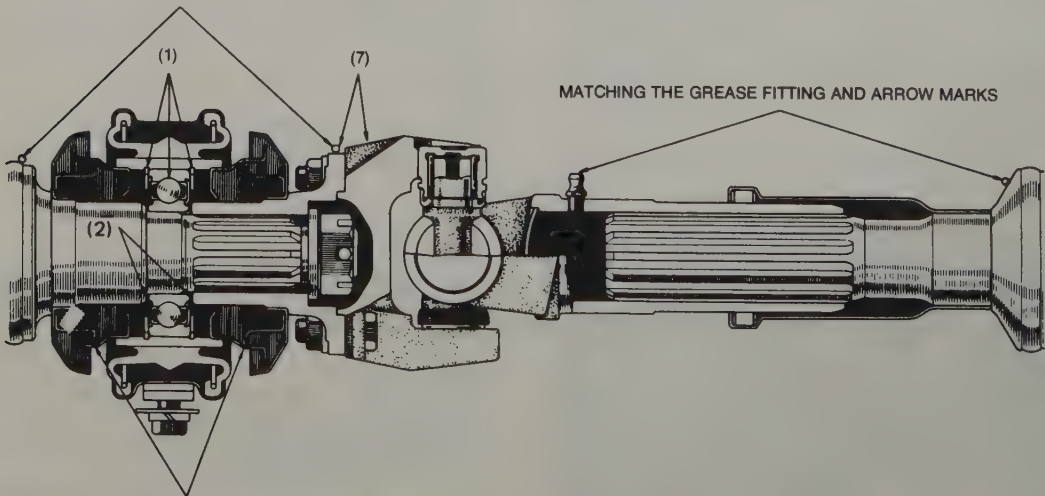
Front Drive Shaft

REMOVAL AND INSTALLATION

4 x 4 Only

- 1. Jack up your vehicle and place jack stands under the front and rear axle housings.

(6) MATCH THE MATING MARKS



(3)(4) WATER DRAIN PLUG

Assembled relationship of the driveshaft components

2. Matchmark both yokes and flanges before removal.
3. Remove the bolts at the rear flange.
4. Remove the bolts from the front flange and remove the drive shaft from the vehicle.
5. Installation is the reverse of removal. Tighten flange bolts 29–43 ft. lb.

UNIVERSAL JOINT OVERHAUL

Universal joints are marked at the factory if oversize parts have been used during assembly. Before buying a rebuilding kit for your truck, note any “V” punch marks on the sleeve yoke, drilled marks, or red painted marks on the bearing caps. These marks will correspond to the oversize parts you will have to get from your dealer. The rebuilding kit or parts you buy should include new bearing seals, snap rings, spiders, and spider bearings.

Although there are special tools available for rebuilding universal joints, you should be able to do the job easily with the assortment of sockets noted in this procedure. Be certain to paint or scratch mating marks on the drive-shaft(s) and universal joint flange yoke(s) before disassembling the joints.

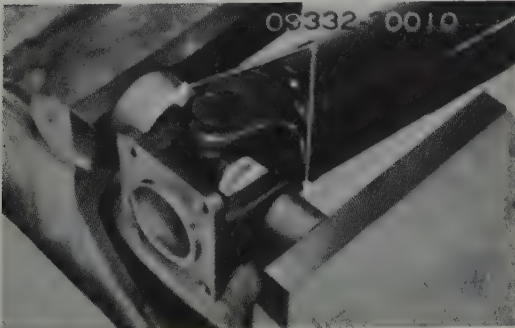
1. Select two sockets. One should be small enough to pass through the universal joint yoke hole. The other should be large enough so that the spider bearing cap fits easily inside it.

2. Remove the snap rings from the bearing holes of the yoke.

3. Position the yoke in a vise so that one socket is centered against a bearing cap and the other socket aligned so that the bearing cap may pass inside of it.

NOTE: Refer to the positions of the service tools in the illustration.

4. Tighten the vise just enough to hold the sockets and yoke in position. Check to see that they are positioned correctly.



Removing the spider bearings, note the position of the service tools



Assembling the universal joint

5. As you tighten the vise, one bearing cap will be pressed against the cross of the U-joint forcing the other cap out of the yoke.

6. Proceed in this manner to remove all caps and then remove the cross.

To assemble:

1. Note any markings and use oversize parts as necessary.

2. Repack the spider bearing cups with grease, and assemble the needle bearing rollers into the cups.

4. Position the spider in the driveshaft yoke. Place the bearing cups inside the lip of the yoke, so that they are held in place by the ends of the spider.

5. Position two sockets of equal size on either side of the bearings, and slip this assembly between the jaws of the vise.

6. As you close the vise, the sockets should force the bearing caps into the holes of the yoke and onto the arms of the spider.

7. After assembling the joints, check the spider thrust play. Select and install new snap rings which will allow a maximum of 0.002 in. of play. The snap rings must be of equal size on opposite arms of the spider.

8. Check the joints for smooth movement and install the driveshaft.

Rear Axle

AXLE SHAFT REMOVAL

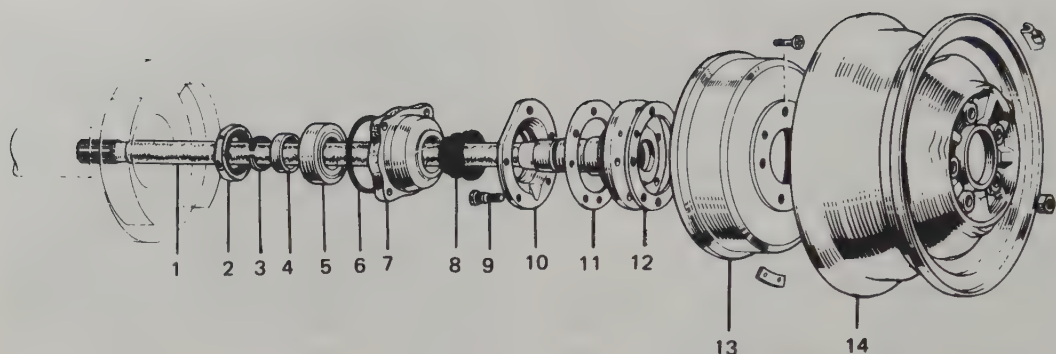
1. Loosen the lug nuts on the wheel, then raise the truck and support it on jackstands.

2. Drain the axle housing.

3. Remove the lug nuts and remove the wheel.

4. Remove the brake drum securing screw and remove the drum.

5. Refer to Chapter 9 for procedures regarding the removal of the rear brake. Remove the brake springs and the retracting spring clamp bolt. Remove the lower springs

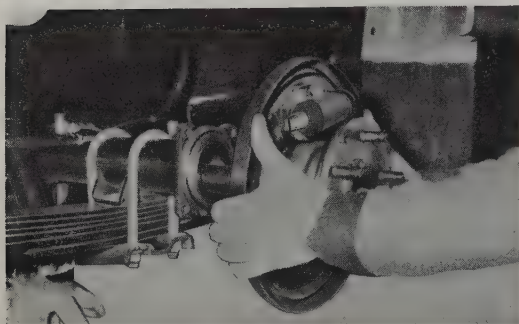


1. Rear axle shaft
2. Type "S" oil seal
3. Shaft snap-ring
4. Rear axle bearing retainer
5. Bearing

6. O-ring
7. Rear axle bearing case
8. Type "K" oil seal
9. Hub bolt
10. Brake drum oil deflector

11. Brake drum oil deflector gasket
12. Brake drum gasket
13. Brake drum
14. Disc wheel subassembly

Rear axle—exploded view



Pull the backing plate and axle shaft from the axle housing

and shoe strut. Remove the brake shoes, screws, and the parking brake lever. Disengage the parking brake cable from the lever and the backing plate.

6. Plug the master cylinder reservoir inlet to prevent the fluid from running out. Disconnect the brake line from the wheel cylinder, being careful not to damage the fitting. Plug the brake line.

7. Remove the four nuts retaining the brake backing plate to the axle housing.

8. Pull the backing plate and axle from the axle housing.

AXLE SHAFT BEARING AND SEAL REMOVAL AND REPLACEMENT

1. Remove the shaft snap ring.
2. The axle shaft must be pressed from the bearing case. To do this, you must support the bearing case and press on the splined end of the axle. Toyota makes a special tool which bolts onto the bearing case. This tool can

then be held while the axle shaft is pressed through.

3. Remove the bearing from the bearing case.

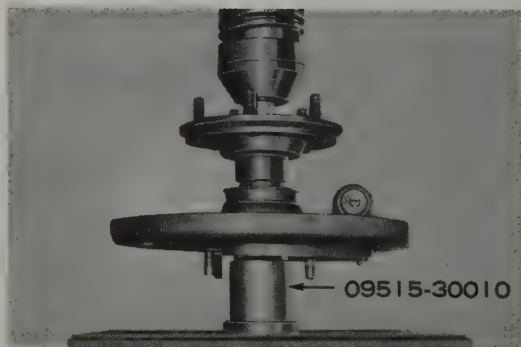
4. Pry the old seals from the axle housing and bearing case with a plastic or wooden tool.

5. If the brake drum oil deflector or gaskets are to be replaced, the hub bolts will have to be pressed from the hub. Install the new deflector and gaskets and press the hub bolts back into the hub.

6. Drive a new axle shaft oil seal into the axle housing with a large socket or pipe. Apply a coating of grease to the lip of the seal after installation.

7. Install a new oil seal into the bearing case with a large socket or pipe.

8. Position a new bearing into the bearing case. Place a large piece of pipe of a diameter which will support the inner race of the bear-



You must support the inner race of the bearing when you press the axle shaft into the bearing case

ing underneath the brake backing plate, and press the axle shaft into the bearing case.

9. Slide the bearing retainer onto the axle shaft. Install the snap ring.

AXLE SHAFT INSTALLATION

1. Install a new O-ring onto the axle housing.

2. Install the axle shaft and brake backing plate assembly into the axle housing. Be careful not to damage the oil seal with the axle splines. Rotate the axle back and forth until the shaft splines mesh with the differential gear splines.

3. Install the brake backing plate nuts and tighten to 44–58 ft. lbs.

4. Install the brake shoes and lever assembly. Connect the parking brake cable and the brake shoe springs. Connect the brake line to the wheel cylinder.

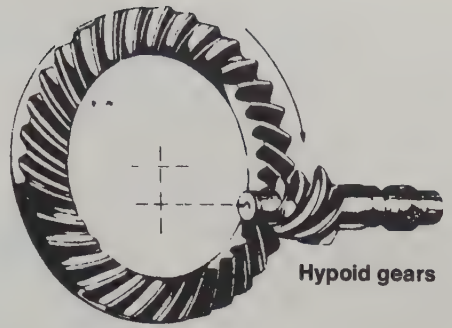
5. After installing the brake drum, bleed the brakes and adjust the brake shoe clearance. Refill the axle housing with SAE 90W GL5 gear oil.

Differential

Differential service is best left to those extremely familiar with them. A great many specialized tools are required as well as a good deal of experience.

INTRODUCTION

The rear axle must transmit power through 90°. To accomplish this, straight cut bevel gears or spiral bevel gears were used. This type of gear is satisfactory for differential side gears, but since the centerline of the gears must intersect, they rapidly became unsuited for ring and pinion gears. The lowering of the driveshaft brought about a variation of the bevel gear, which is called the hypoid gear.

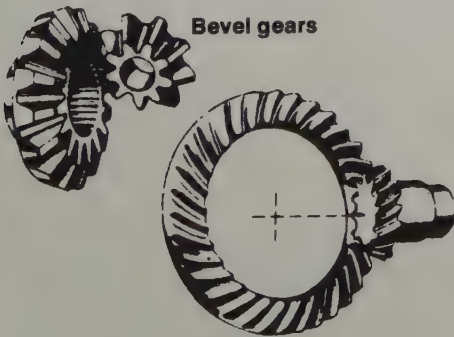


This type of gear does not require a meeting of the gear centerlines and can therefore be underslung, relative to the centerline of the ring gear.

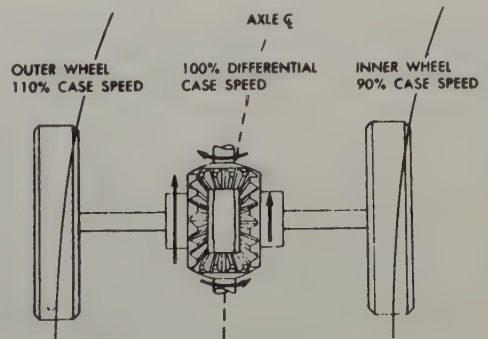
OPERATION

The differential is an arrangement of gears which permits the rear wheels to turn at different speeds when cornering and divides the torque between the axle shafts. The differential gears are mounted on a pinion shaft and the gears are free to rotate on this shaft. The pinion shaft is fitted in a bore in the differential case and is at right angles to the axle shafts.

Power flow through the differential is as follows. The drive pinion, which is turned by the driveshaft, turns the ring gear. The ring gear, which is bolted to the differential case, rotates the case. The differential pinion forces the pinion gears against the side gears. In cases where both wheels have equal traction, the pinion gears do not rotate on the pinion shaft, because the input force of the pinion gear is divided equally between the two side gears. Consequently the pinion gears revolve with the pinion shaft, although they do not revolve on the pinion shaft itself. The side gears, which are splined to the axle



Spiral bevel gears



Differential action during cornering (Courtesy Chevrolet Motor Division)

shafts, and meshed with the pinion gears, rotate the axle shafts.

When it becomes necessary to turn a corner, the differential becomes effective and allows the axle shafts to rotate at different speeds. As the inner wheel slows down, the side gear splined to the inner wheel axle shaft also slows down. The pinion gears act as balancing levers by maintaining equal tooth loads to both gears while allowing unequal speeds of rotation at the axle shafts. If the vehicle speed remains constant, and the inner wheel slows down to 90 percent of vehicle

speed, the outer wheel will speed up to 110 percent.

GEAR RATIO

All Toyota Pickups (1970–80) have an axle ratio of 4.11:1. This means that the drive shaft will turn 4.11 times for every turn of the rear wheel. The number 4.11 is determined by dividing the number of teeth on the pinion gear into the number of teeth on the ring gear ($37 \div 9 = 4.11$).

On 1981 Toyota pickups the rear ratios vary from 4.11, 3.90, 3.73, to 3.58, and 3.42.

Suspension and Steering



FRONT SUSPENSION— 2-WHEEL DRIVE

The front suspension is of conventional design. It has upper and lower control arms with ball joints, coil springs, and shock absorbers.

Springs

REMOVAL AND INSTALLATION

CAUTION: Removal of the coil springs is a dangerous job and should only be undertaken with that awareness in mind. Read the procedure carefully before deciding to do the job.

You will need two special tools to perform this job: a coil spring compressor, and a gear puller which will fit both the tie-rod end and the ball joint.

1. Remove the wheel and tire.
2. Raise the front of the truck and support the front suspension cross-member with jackstands.
3. Remove the stabilizer bar connecting bolts and bracket.
4. Remove the tie-rod cotter pin and castle nut. Remove the tie-rod end from the knuckle with a gear puller.

NOTE: Before proceeding further, run a length of chain through the coil spring and



Removing the stabilizer bar

the bottom of the suspension arm, to prevent the spring from launching itself on a surprise attack.

5. Remove the shock absorber. See appropriate section in this chapter.

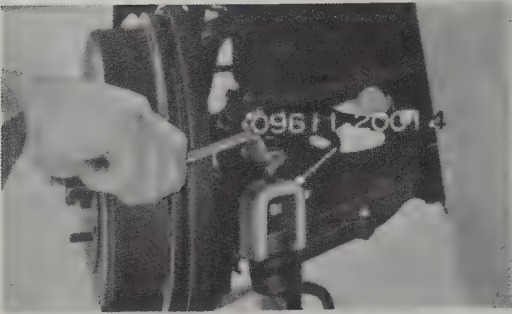
NOTE: Disconnect the flexible brake hose before proceeding. Plug the master cylinder inlet to prevent the fluid from running out.

6. Raise the lower control arm with a jack so that the arm is free of the steering knuckle.

7. Loosen the ball joint attaching nut and remove the ball joint with a puller.

8. Slowly and carefully lower the control arm utilizing the jack.

CAUTION: If the jack is released too quickly, the spring will jump out of its



Separating the tie-rod end



Removing the lower ball joint

mounting causing bodily injury if you are in the area.

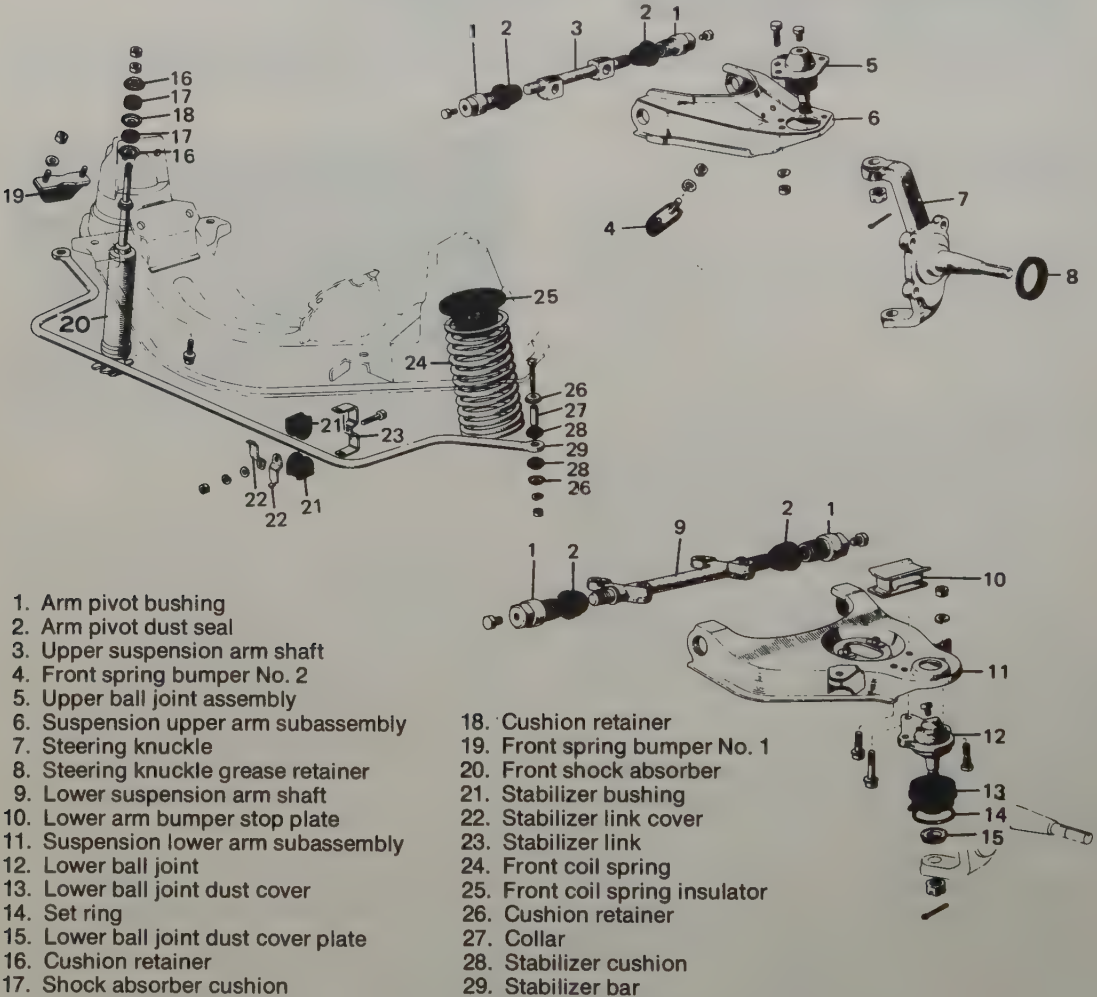
9. Remove the coil spring and insulator from under the truck.

10. When installing the spring a coil spring compressor must be used to insert the coil in its proper position. Use new cotter pins, and tighten the lower ball joint nut to

65–94 ft. lbs. on RN12 and 14 trucks, and 87–123 ft. lbs. on all later models. Tighten the tie-rod to steering knuckle nut to 54–80 ft. lbs. on all trucks. Bleed the brake before operating the truck.

4 x 4 Only

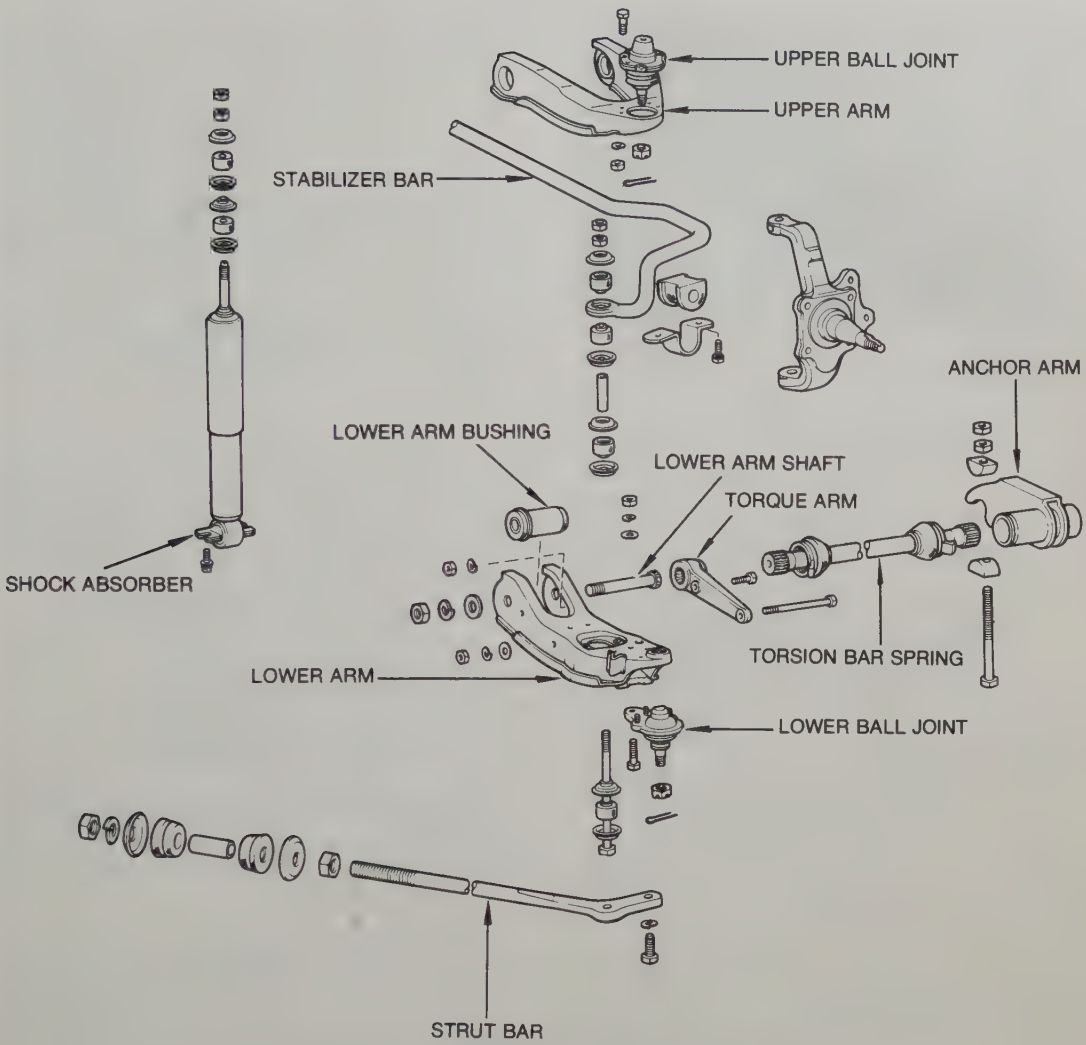
See front suspension removal and installation



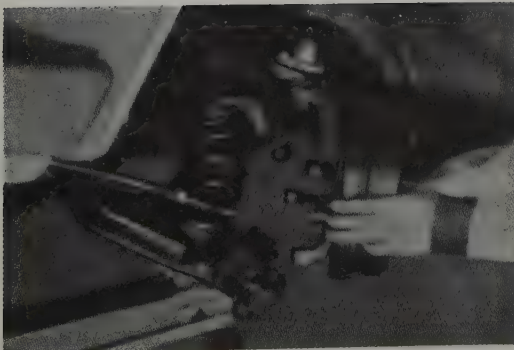
1. Arm pivot bushing
2. Arm pivot dust seal
3. Upper suspension arm shaft
4. Front spring bumper No. 2
5. Upper ball joint assembly
6. Suspension upper arm subassembly
7. Steering knuckle
8. Steering knuckle grease retainer
9. Lower suspension arm shaft
10. Lower arm bumper stop plate
11. Suspension lower arm subassembly
12. Lower ball joint
13. Lower ball joint dust cover
14. Set ring
15. Lower ball joint dust cover plate
16. Cushion retainer
17. Shock absorber cushion

18. Cushion retainer
19. Front spring bumper No. 1
20. Front shock absorber
21. Stabilizer bushing
22. Stabilizer link cover
23. Stabilizer link
24. Front coil spring
25. Front coil spring insulator
26. Cushion retainer
27. Collar
28. Stabilizer cushion
29. Stabilizer bar

Components of the 1970–78 front suspension



Front suspension components 1979 and later



Coil spring removal



Installing the coil spring using a compressor



Removing the front shock absorber and disconnecting the flexible brake line

Shock Absorber

REMOVAL AND INSTALLATION

1. Remove the wheel and tire.
2. Support the front suspension cross-member with jackstands.
3. Using two wrenches loosen the two nuts on the top of the shock absorber.
4. Remove the two lower mounting bolts on the shock absorber and remove the unit from the truck. Inspect the shock absorber as outlined below.
5. Before installing the shock absorber, purge it of air. Fully extend the rod, then turn the shock upside down and compress the rod. Repeat the procedure four or five times, then fully extend the rod for installation.
6. Tighten the lower bolts first, then install the upper mounting grommets and tighten the upper nuts.

NOTE: Upper securing nuts—14–22 ft. lbs. Lower mounting bolts—11–16 ft. lbs.

SHOCK ABSORBER INSPECTION

With the shock absorber removed from the vehicle examine it for the following:

1. Fluid leaks
2. Damaged housing
3. Weakness
4. Wear
5. Bent or cracked mounting studs

Test the shock absorber operation by placing it in an upright position; push and pull on the unit. If it presents little resistance or if it binds, replace it.

Ball Joints

INSPECTION

To check the lower ball joint for wear, jack up the lower suspension arm, after removing all excess play from the other suspension

parts (wheel bearings, tie-rods, etc.). The bottom of the tire should not move more than 0.2 in. when the tire is pushed and pulled inward and outward. The tire should not move more than 0.09 in. up and down. If the play is greater than these figures, replace the ball joint. The upper ball joint should be replaced if a distinct looseness is felt when turning the ball joint stud with the steering knuckle removed.

REMOVAL AND INSTALLATION

1970–78

1. Remove the wheel and tire.
2. Support the front suspension cross-member with jackstands.
3. Place a jack under the lower control arm and raise the control arm until the spring bumper is off the frame.
4. Disconnect the flexible brake hose.
5. Disconnect the tie-rod end from the steering knuckle using a puller.
6. Using a suitable puller remove the ball joint from the steering knuckle.
7. Remove the ball joint from the lower arm.
8. From this position the upper ball joint may also be removed in a similar manner. Removal and installation will be easier if the lower is removed first.
9. Install the new ball joints and reassemble the steering components. Due to the fact that the shock absorber is not removed in this procedure the coil spring may be positioned with the jack and no compressor is necessary.

NOTE: Be sure to grease the new ball joints before using the vehicle.

10. Tighten the upper ball joint nuts to 15–22 ft. lbs., the lower to 22–29 ft. lbs. Tighten the steering knuckle to the upper joint to 65–94 ft. lbs.; the knuckle to the lower joint to 65–94 ft. lbs. on RN12 and 14s (1970–72 Hi-Lux), and 87–123 ft. lbs. on all other trucks. Bleed the brakes before driving the truck.

1979 and later

1. Jack up the vehicle and support it with jackstands.
2. Remove the front wheel.
3. Support the lower control arm with a jack.
4. Remove the brake caliper and tie it out of the way. See Chapter 9.
5. Remove the tie rod end.

6. Remove the ball joint from the steering knuckle.

NOTE: You can also remove the upper ball joint now if needed. Removal and installation will be easier if the bottom joint is removed first.

8. Installation is the reverse of removal.

NOTE: Be sure to grease the ball joints before moving the vehicle.

The following torque values are needed. Upper mounting bolts 15–21 ft. lb. Upper ball joint 66–94 ft. lb. lower mounting bolts 15–39 ft. lb. lower ball joint 87–122 ft. lb.

Control Arms

REMOVAL AND INSTALLATION

Lower Arm

1970–78

1. Remove the coil spring as outlined earlier in this chapter.

2. Remove the four bolts which retain the inner shaft to the frame and remove the arm.

3. Installation is the reverse of removal. Tighten the ball joint to 22–29 ft. lbs. Tighten the four shaft mounting bolts to 51–65 ft. lbs. on RN12 and 14s (1970–72 Hi-Lux), and 33–43 ft. lbs. on all other trucks.

1979 and later

1. Remove the torsion bar spring.
2. Disconnect the stabilizer from the lower control arm.

3. Remove the strut bar.
4. Remove the front shock.
5. Disconnect the bottom ball joint.

NOTE: To remove the bottom ball joint a puller must be used.

6. Remove the lower arm nut and shaft.
7. Remove the torque arm, the lower arm nut, shaft, and pull the lower arm down.



Removing the lower control arm

8. Installation is the reverse of removal. Torque the lower arm bolts and nuts 29–39 ft. lb. Lower ball joint bolts 21–39 ft. lb. Lower ball joint 87–122 ft. lb. The strut bar 55–75 ft. lb. stabilizer 8–11 ft. lb., lower arm nut 145–216 ft. lb.

NOTE: Remove the jack stands and bounce the vehicle to stabilize the lower arm bushings.

Upper Arm

1970–78

1. Jack up the front of the vehicle and support the front crossmember on jackstands.

2. Remove the wheel and tire.

3. Raise the lower control arm with another jack.

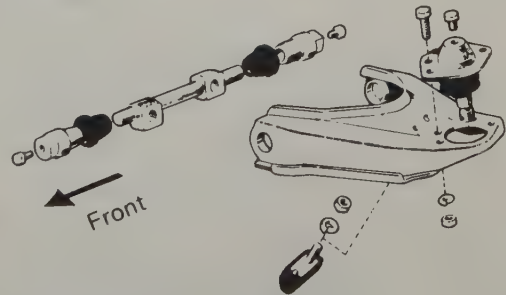
4. Remove the cotter pin and castle nut on the upper ball joint stud of the steering knuckle.

5. Using a suitable puller, separate the ball joint stud from the steering knuckle.

6. There are two bolts holding the control arm inner shaft to the frame. Behind these bolts are the shims for adjustment of the front end alignment. When removing the bolts be certain that you count the number of shims.

7. Remove the two bolts and remove the control arm from the vehicle.

8. Installation is in the reverse order. The only precaution is in regard to the placement of the shims. They must be positioned exactly as they were before disassembly. Tighten the two mounting bolts to 95–153 ft. lbs. Tighten the steering knuckle to the ball joint stud to 65–94 ft. lbs. Be sure to use a new cotter pin.



Upper control arm—exploded view

1979 and later

1. Remove the upper ball joint from the steering knuckle.

2. Remove the mounting bolts and adjusting shims.

NOTE: Do not lose these shims. Record

the position and the thickness so they can be reinstalled in the proper place.

3. Installation is the reverse of removal. The following torque figures are required. Upper arm bolts 51–65 ft. lb. Ball joint 66–94 ft. lb.

Torsion Bar

REMOVAL AND INSTALLATION

1979 and later

1. Jack up the vehicle and support it on jack stands.

2. Remove the rubber boots. Place matchmarks on the torsion bar spring, anchor arm and torque arm.

3. Remove the locknut and measure the anchor arm bolt height.

NOTE: You will need this measurement when adjusting the vehicle height.

4. Remove the adjusting nut and remove the anchor arm and torsion bar spring.

5. Installation is the reverse of removal.

Strut Bar

REMOVAL AND INSTALLATION

1979 and later

1. Place a matchmark on the threaded portion and the nut.

2. Remove the nut from the strut bar.

3. Remove the strut bar bolts and remove the strut bar.

4. Installation is the reverse of removal.

Stabilizer Bar

REMOVAL AND INSTALLATION

1979 and later

1. Remove one torsion bar spring. See torsion bar removal and installation.

2. Remove the nuts, bushings and bolts holding the stabilizer bar.

3. Remove the stabilizer bar.

4. Installation is the reverse of removal.

Steering Knuckle

REMOVAL AND INSTALLATION

1979 and later

1. See front hub removal in this chapter.

2. Support the lower control arm with a jack.

3. Remove the tie rod end.

4. Use a puller to remove the bottom ball joint from the knuckle.

5. Remove the upper ball joint.

6. Installation is the reverse of removal.

Tighten the upper ball joint 66–94 ft. lb. Lower ball joint 87–122 ft. lb.

Front Axle Hub

REMOVAL AND INSTALLATION

1979 and later

1. Jack up your vehicle and support it with jack stands.

2. Remove the front wheel.

3. Remove the brake caliper and tie it out of the way.

4. Remove the bearing cap, cotter pin, locknut, and inner nut.

5. Remove the axle hub, thrust washer and outer bearing.

6. Remove the inner bearing and oil seal.

7. Installation is the reverse of removal.

Front Axle Shaft (4WD Only)

REMOVAL AND INSTALLATION

See front axle hub removal and installation.

Front Axle Hub

REMOVAL AND INSTALLATION

4 x 4 Only

1. Set the control handle in the free position.

2. Remove the bolts in the hub and remove the hub and gasket.

3. Remove the nuts, spring washers and cone washers.

NOTE: Cone washers can be removed by using a tapered punch.

4. Remove hub body and gasket.

5. Remove snap ring from free wheel hub body.

6. Remove hub ring, spacer and inner hub.

7. Remove compression spring, follower, tension spring, and clutch.

8. Remove snap ring, free wheel hub cover, ball and spring, seal, and control handle.

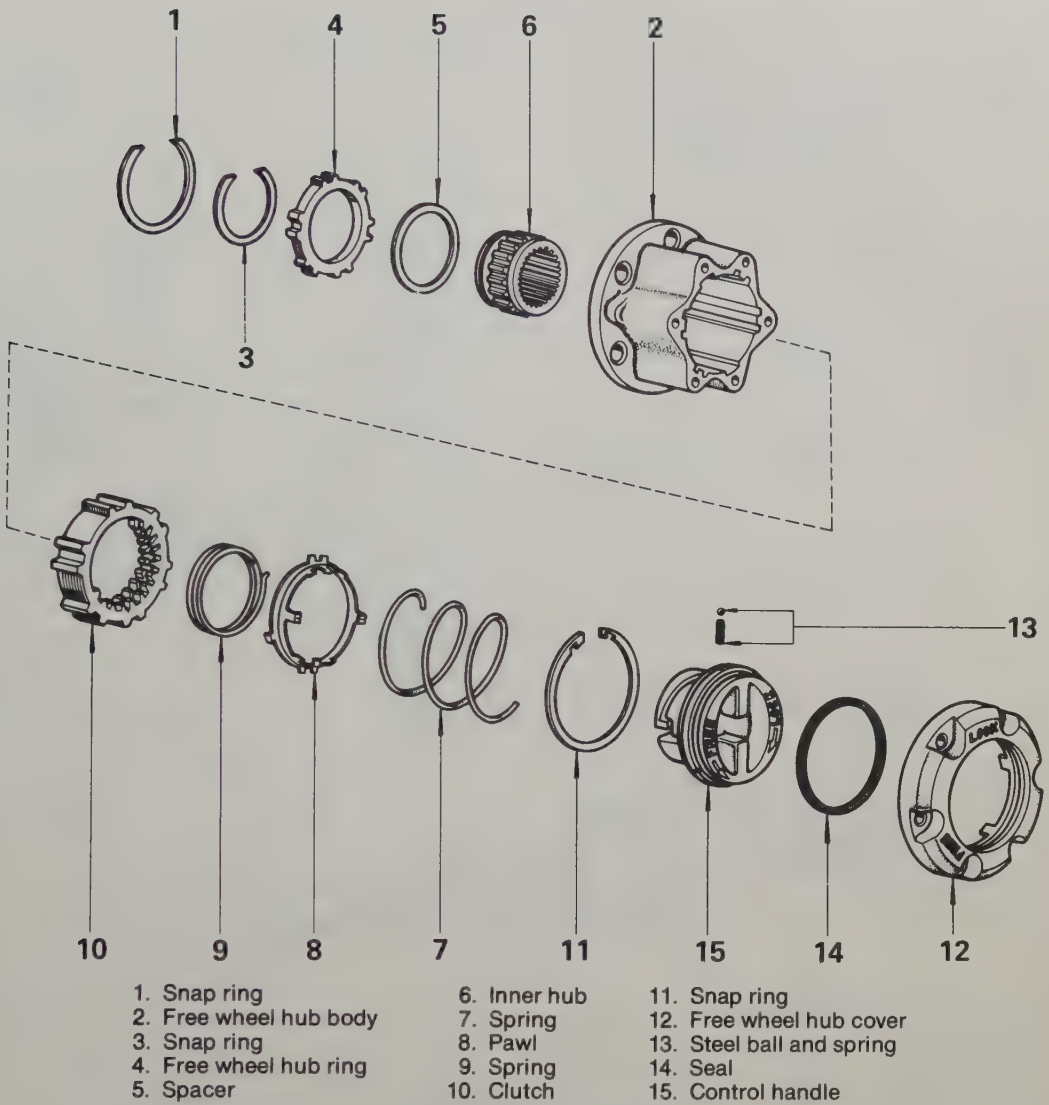
NOTE: Check inner hub and free wheel hub ring oil clearance. Clearance should be 0.012 in.

9. Disconnect the brake line and the two bolts holding the brake caliper.

10. Remove the dust cap and snap ring.

11. Remove the cone washers with a tapered punch.

12. Remove the flange by installing two bolts in the special holes for flange removal.



Exploded view of free wheel hub

Tighten these bolts until the flange comes loose. Remove the bolts by loosening them and remove the flange.

13. Remove the locknut, washer, and adjusting nut. Pull the rotor assembly off the spindle. The outer and inner bearings and seal will come apart as a unit.

14. Set the rotor on two blocks of wood. Using a drift pin drive the seal out. The inner bearing will drop out at this time. Using this pin drive the front and rear race from the rotor.

15. Place the rotor in a vice and remove the front axle hub.

16. Inspect the rotor, spindle, and hub for damage.

17. Remove the dust seal, gasket, and dust cover.

18. Remove the spindle and gasket.

19. Position the flat part of the out shaft up and pull out the shaft.

20. Remove the oil seal retainer.

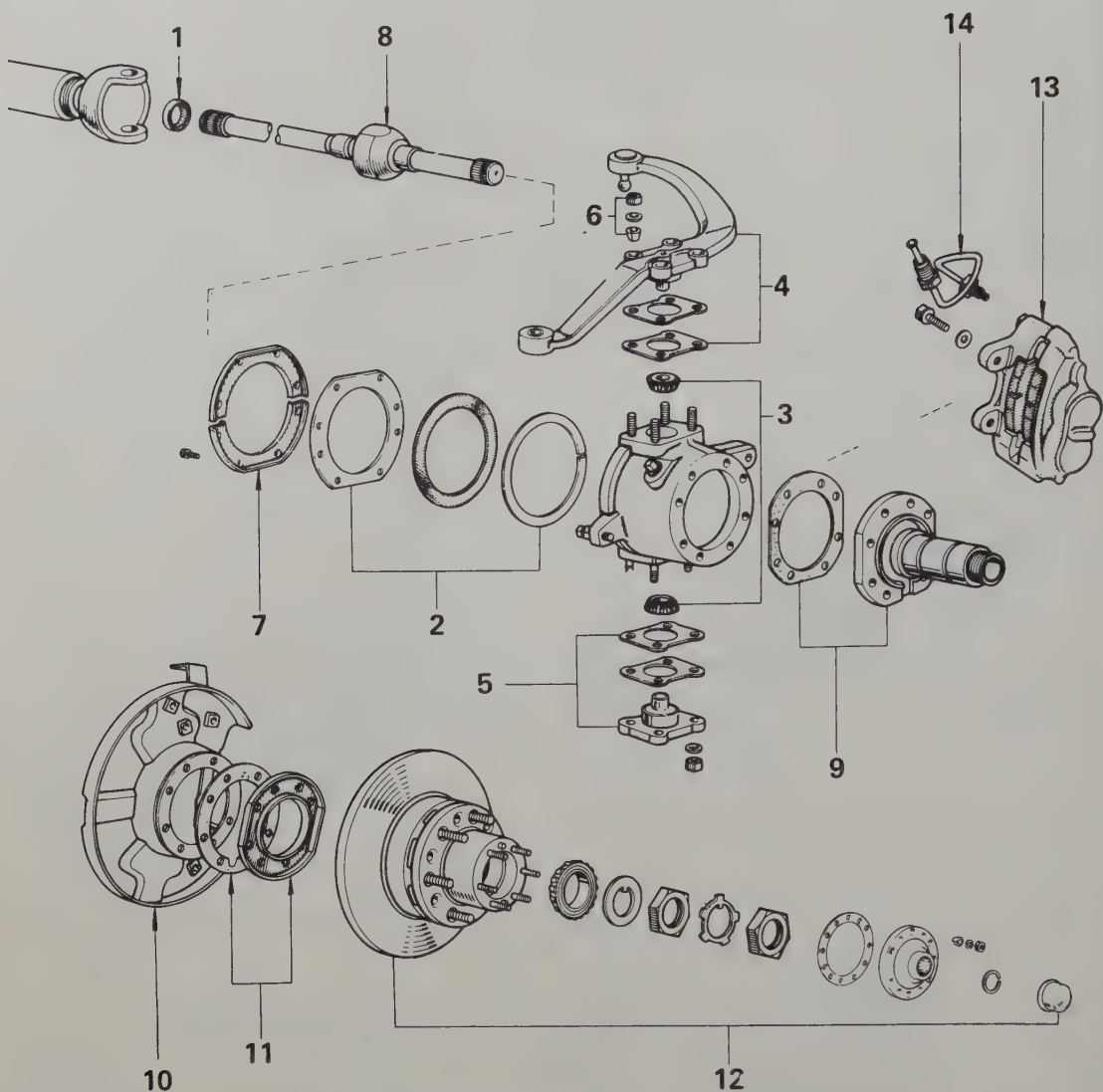
21. Remove the cone type washers from the drag link with a tapered punch.

22. Remove the drag link and tie rod.

23. Remove the bottom bearing cap and shim.

24. Remove the upper and lower bearings with the proper tool.

NOTE: The steering knuckle bearing remover is available from your Toyota dealer. Part #09606-60010. Remember to



1. Oil seal
2. Oil seal set
3. Bearings
4. Steering knuckle
5. Bearing cup and shim

6. Nut, washer, dowel
7. Oil seal retainer
8. Front axle shaft
9. Knuckle spindle and gasket
10. Dust cover

11. Dust seal and gasket
12. Front axle hub with disc
13. Brake caliper
14. Brake line

Steering knuckle and axle shaft

mark the bearings in order to reassemble them in their proper place:

25. Remove the upper and lower races with a brass drift pin.

26. Remove the steering knuckle and inspect for damage or wear.

27. Place the inner shaft in a vice. Using a drift pin drive the outer shaft apart and remove six ball bearings.

NOTE: Tilt the inner race and cage. Take the balls out one at a time.

28. Remove the cage and race from the shaft.

NOTE: Turn the large opening in the cage against the protruding portion of the shaft, pull the race and cage out.

29. Remove the inner race from the cage through the large opening.

30. Remove the inner oil seal. Thoroughly wash and inspect all parts for wear or damage.

31. Installation is the reversal of removal with the following suggestions.

1. Replace all oil and grease seals.
2. Pack the hub interior, inner and outer bearings with a multipurpose grease.

3. Coat the birfield joint with molybdenum disulphide lithium base grease before assembly.

NOTE: Be sure to place the cage wide side and the protruding side of the race outward.

4. Pack molybdenum disulphide lithium base grease in the outer shaft.

5. After installing the outer shaft on the inner shaft check to see that they will not come apart.

NOTE: Before installing the shaft coat the knuckle bearings and fill the knuckle about $\frac{3}{4}$ full of molybdenum disulphide lithium base grease.

6. Test the bearing preload by using a scale attached to the steering knuckle. This adjustment should be 4.0–8.4 lb.

NOTE: If the preload is incorrect, because of the special tools needed to reset it we recommend you have this done at your local dealer after you have the vehicle back together.

Tightening Specifications:

- Free wheel hub body bolts 21–25 ft. lbs.
- Hub cover 6–8 ft. lbs.
- Hub mounting bolts 29–39 ft. lbs.
- Adjusting nut 43 ft. lbs.
- Lock nut 58–72 ft. lbs.
- Flange bolts 21–25 ft. lbs.
- Caliper bolts 55–75 ft. lbs.
- Brake line 10–13 ft. lbs.
- Knuckle arm and bearing caps 62–79 ft. lbs.
- Tie rod 55–79 ft. lbs.
- Dust cover 23–39 ft. lbs.

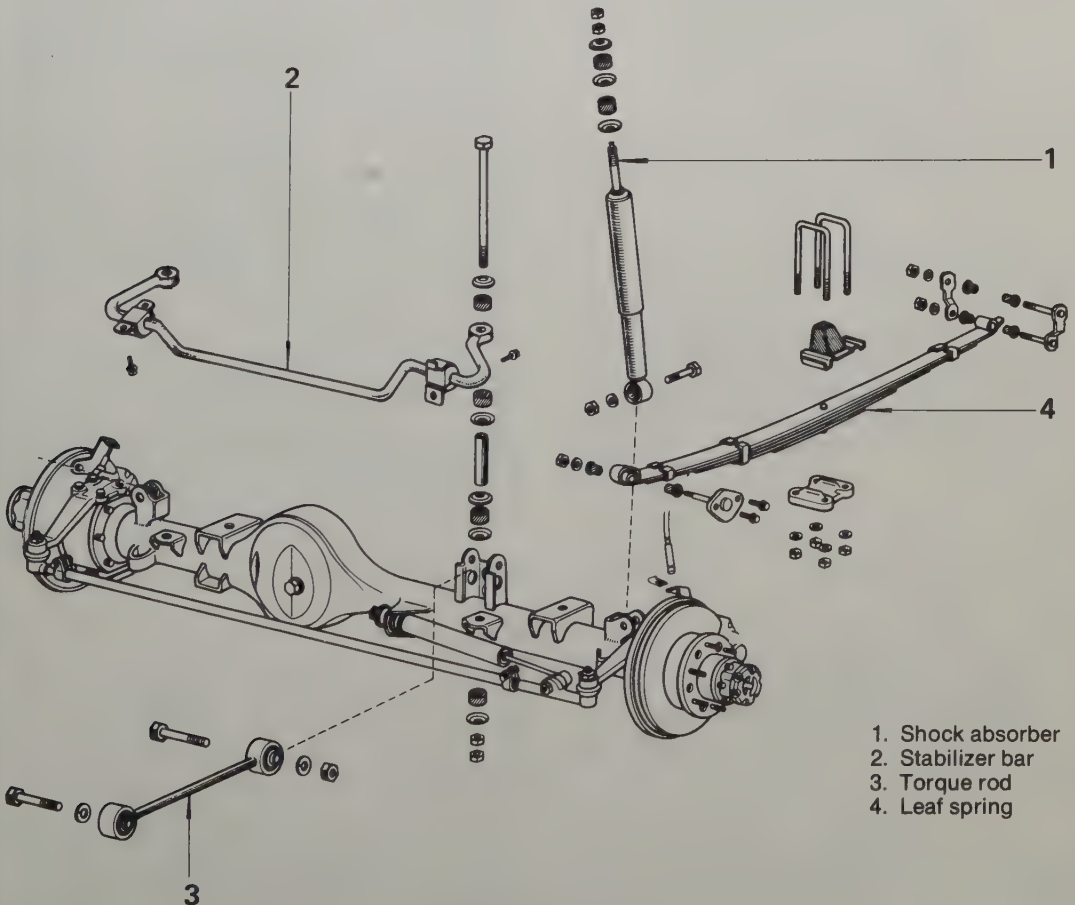
FRONT SUSPENSION—4-WHEEL DRIVE

REMOVAL AND INSTALLATION

1. Jack up the vehicle and support it on jack stands along the frame.

NOTE: Support the front rear housing with a jack.

2. Remove the top and bottom shock



1. Shock absorber
2. Stabilizer bar
3. Torque rod
4. Leaf spring

Front suspension 4 wheel drive

bolts. 3. Remove the stabilizer end bolts and mount bolts.

4. Remove the stabilizer bar.

5. Remove the torque rod bolts and remove the torque rod.

NOTE: Torque rod bushings must be removed by a press.

6. Remove the drag link from the steering knuckle arm.

7. Disconnect the brake lines.

NOTE: Allow the brake fluid to drain into a container.

8. Remove the U-bolts and spring seat.

9. Remove the spring bumper.

10. Remove the rear shackle pins.

11. Remove the front hanger pins.

12. Lower the jack supporting the front rear and lift the spring out.

13. Installation is the reversal of removal with the following suggestions.

1. Thoroughly check all suspension parts for wear or damage.

2. Bleed the brake system.

Tightening specifications.

1. Bottom shock bolts 26–39 ft. lb.

2. Upper shock bolts 14–22 ft. lb.

3. Stabilizer bar mounts 8–11 ft. lb.

4. Stabilizer end bolts 14–22 ft. lb.

5. Torque rod bolts 87–123 ft. lb.

6. Front hanger pin 8–11 ft. lb.

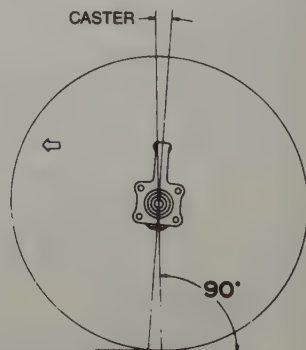
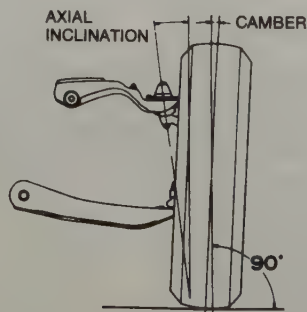
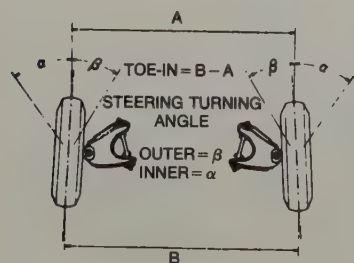
7. Front hanger pin nut 55–79 ft. lb.

8. Shackle pins 55–79 ft. lb.

Front End Alignment

CAMBER

The wheel is not positioned vertically on most vehicles, but is angled so that the upper edge is farther away from the chassis than the lower edge. Angling the wheel in this manner makes better use of the tire tread when cornering.



Relationships of the wheel to the road and suspension components—camber, caster, and toe-in are illustrated

Camber adjustment is achieved with the aid of shims. These shims are located behind the inner shaft of the upper control arm. Due to the complexity of determining what size shims are needed, the adjustment is better left to a shop. Camber adjustments are not possible on 4WD trucks. If adjustments are necessary, check for worn parts.

CASTER

The upper end of the steering knuckle is positioned slightly behind the lower end; this relationship is called caster.

Caster helps the vehicle's steering return to the straight-ahead position and improves directional stability.

Caster is also adjusted with shims and special equipment is required to obtain accurate settings. Caster adjustments are not possible on 4WD trucks. If adjustments are necessary check for worn parts.

TOE-IN

When the front wheels are stationary, they are closer together at the front than at the rear. Aligning the wheels in this manner compensates for various frictional forces which alter the angles between the wheels when the vehicle is moving. Thus the wheels are brought into a parallel position relative to each other as the vehicle gains speed. Toe-in is measured in inches and is the difference between the distance separating the wheels at the front and rear centerlines.

Tie-rod ends are increased or decreased in length to adjust the toe-in.

REAR SUSPENSION

The rear suspension consists of leaf springs and shock absorbers.

Wheel Alignment Specifications

Year	Model	CASTER		CAMBER		Toe-in (in.)	Steering Axis Inclination (deg)
		Range (deg)	Preferred Setting (deg)	Range (deg)	Preferred Setting (deg)		
1970-71 1971-72	RN-12 RN-14	—	1/3 N	—	—	1 P	1/4
1972-74	RN-22 RN-27	1/4 P-1 1/4 N	1/2 N	—	1/4-1 3/4 P	1 P	3/16
1975-78	RN-23 RN-28	0-1 P	1/2 P	—	1/2-1 1/2 P	1 P	0.24
1979-81	RN-32L RN-42L	1/2 P-1/2 N	1/2 P	—	1/12-1/2 P	1 P	0.20-+ 0.04 in. ① 0.08-+ 0.04 in. ②
1979-81	RN-37L RN-47L (4WD)	—	3/2	—	—	1 P 9 1/2 ③	0.16-+ 0.04 in. ① 0.04-+ 0.04 in. ②

① Bias Ply Tire

② Radial Ply Tire

③ King Pin Inclination (4WD only)

Springs

REMOVAL AND INSTALLATION

1. Jack up the rear of the truck and support the frame and the rear axle housing with jackstands.

2. Remove the wheel and tire.

3. Remove the cotter pin, nut, and cushion washer from the shock absorber lower end. Remove the shock absorber from the spring U-bolt seat. Do the same on the upper mounting and remove the shock absorber.

4. Disconnect the parking brake equalizer from the parking brake intermediate lever.

5. Remove the bolt which secures the three-way brake line junction to the rear axle housing.

6. Loosen and remove the U-bolt nuts, remove the U-bolts and the spring seat.

7. Using a jack, take the weight off the rear springs by raising the rear axle housing.

8. Remove the spring shackle nuts and take out the spring shackle inner plate. Pry the spring shackle off with a pry bar.

9. Remove the bolts retaining the spring hanger pin and the hanger pin nut. Drive the hanger pin out of the hanger.

10. Remove the rear spring from the vehicle.

Installation is performed in the following manner:

1. Install the spring hanger pin and nut through the spring and hanger, but do not tighten the nut.

NOTE: Apply a soap and water solution to the rubber bushings; this will make installation of the parts much easier.

2. Install the spring on the shackle, replace the shackle parts, but do not tighten the nuts.

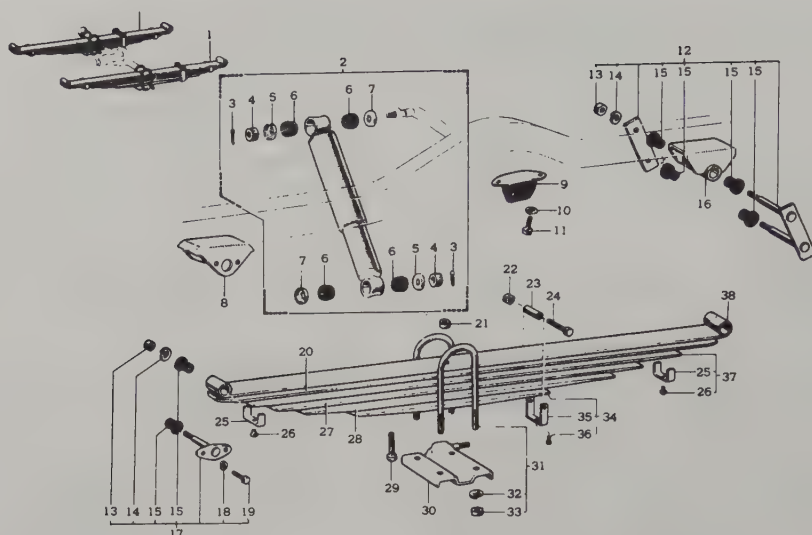
3. Position the spring center bolt head in the hole in the spring seat. Install the U-bolts and the nuts. Tighten the nuts to 80 ft. lbs.

4. Raise the housing off the stands. Tighten the shackle nuts to 75 ft. lbs. and do the same with the spring hanger nut.

5. Install the shock absorber and tighten the retaining nuts to 25-40 ft. lbs.

NOTE: If the spring hanger and shackle bolts are tightened with no load on them the bushings will be damaged.

6. Connect the parking brake equalizer, the three-way fitting bolt, replace the wheel and tire, and lower the vehicle.



- | | | |
|----------------------------------|----------------------------|-----------------------------|
| 1. Rear spring | 14. Spring washer | 27. Rear spring leaf |
| 2. Rear shock absorber | 15. Bushing | 28. Rear spring leaf No. 5 |
| 3. Cotter pin | 16. Spring bracket | 29. Rear spring center bolt |
| 4. Castle pin | 17. Rear spring hanger pin | 30. U-bolt seat |
| 5. Shock absorber cushion washer | 18. Spring washer | 31. U-bolt |
| 6. Bushing | 19. Bolt | 32. Spring washer |
| 7. Shock absorber cushion washer | 20. Rear spring leaf | 33. Nut |
| 8. Spring bracket | 21. Nut | 34. Rear spring leaf |
| 9. Rear spring bumper | 22. Nut | 35. Rear spring clip |
| 10. Spring washer | 23. Rear spring clip bolt | 36. Round rivet |
| 11. Bolt | 24. Clip bolt | 37. Rear spring leaf |
| 12. Rear spring shackle | 25. Rear spring clip | 38. Rear spring leaf |
| 13. Nut | 26. Round rivet | |

Rear spring and shock absorber

Shock Absorbers

REMOVAL AND INSTALLATION

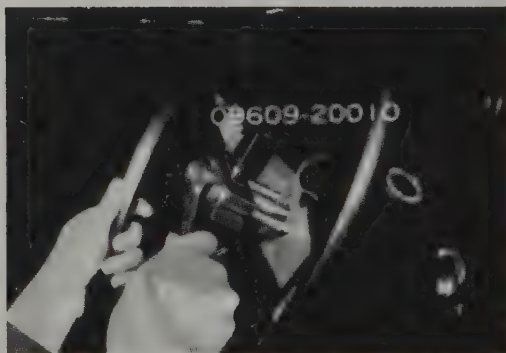
It is not necessary to jack up the truck to remove or install the rear shock absorbers. However, you will be safer if you support the axle on jackstands, in case a tire goes flat while you're under there.

1. Remove the cotter pin, nut, and cushion washer from the shock absorber lower end. Do the same on the upper mount, and remove the shock absorber.

2. Check the shock absorber for wear as outlined under Shock Absorber Inspection earlier in the Chapter.

3. Purge the shock absorber of air before installing. Fully extend it, then invert and compress it. Repeat this procedure four or five times, then extend the shock for installation.

4. Install the shock absorber and cushion washers, and tighten the nuts to 25–40 ft. lbs. Use new cotter pins to lock the nuts in place.



Removing the steering wheel

STEERING

Steering Wheel

REMOVAL AND INSTALLATION

1. Disconnect the wiring harness at the lower end of the steering column under the dash.

2. Remove the three screws on the back of

the steering wheel which hold the horn pad in place.

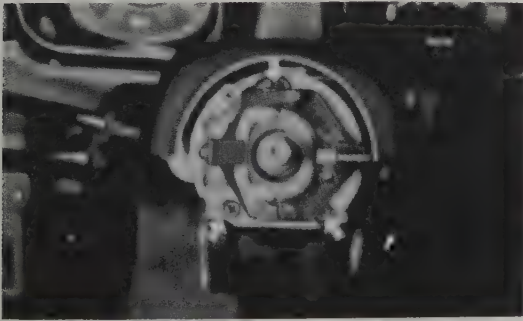
3. Remove the steering wheel retaining nut and, using a steering wheel puller, remove the steering wheel.

4. Installation is the reverse of removal. Torque the retaining nut to 15–22 ft. lbs.

Turn Signal Switch

1. Remove the steering wheel.
2. Remove the steering column lower cover by removing the five retaining screws.
3. Remove the three large phillips head retainer screws and remove the switch.
4. Position the switch in the neutral position for installation.

NOTE: When working on the steering column be careful not to damage the collapsible mechanism in the column.



Turn signal switch replacement

Ignition Switch

The ignition switch lock cylinder comes out of the housing very easily. Simply remove the upper and lower cover by taking out the five retaining screws. Turn the switch to the "Accessory" position and insert a cotter pin or piece of welding rod into the tiny stop pin hole. Push in on the stop pin and remove the unit with the key.

Steering Linkage

REMOVAL AND INSTALLATION

2-Wheel Drive

The steering linkage must be removed as an assembly in order to replace any defective parts except tie-rod ends.

1. Raise the front end of the truck and support the front crossmember on jackstands. Remove the front wheels.

2. Remove the nut on the pitman arm and using a puller remove it from the steering sector shaft.

3. Unfasten the idler arm support securing bolts and remove the support from the frame.

4. Remove the castle nuts and cotter pins from the tie-rod ends and separate them from the steering knuckle arms with a puller.

5. Remove the shimmy dampner 1979 and later.

6. Remove the relay rod complete with the tie-rods, pitman arm, and idler arm.

7. The pitman and idler arms, and the tie-rod ends must be removed from the relay rod with a puller.

8. Tie-rod ends are removed from the adjusting tube by loosening the clamp securing nut.

Note the following items upon reinstallation:

1. Use new cotter pins at all locations. Tighten the tie-rod end-to-steering knuckle nuts, pitman arm-to-relay rod, and idler arm-to-relay rod, to 54–80 ft. lbs. (35–50 ft. lbs. on 1970–72 Hi-Lux, RN12 and 14).

2. Tighten the tie-rod end clamp nuts to 15–22 ft. lbs. The adjustment of the tie-rod ends within the tube must be equal. The tube clamp bolt must be positioned at the tube slot. The tie-rod ends should be at a 90° angle to each other.

3. Coat the lips of any dust seals replaced with grease before installation.

4. If the idler arm has been removed from its support, the arm must be installed at a 7° angle from the mounting surface of the support bracket (9° for RN12 and 14). Tighten the idler arm-to-support nut to 58–87 ft. lbs.

5. Tighten the pitman arm-to-sector shaft bolt to 80–90 ft. lbs.

6. Tighten the idler arm support-to-frame bolts to 25–35 ft. lbs.

7. Align the marks on the pitman arm and sector shaft before installing the pitman arm.

8. Have the alignment adjusted upon completion of any work.

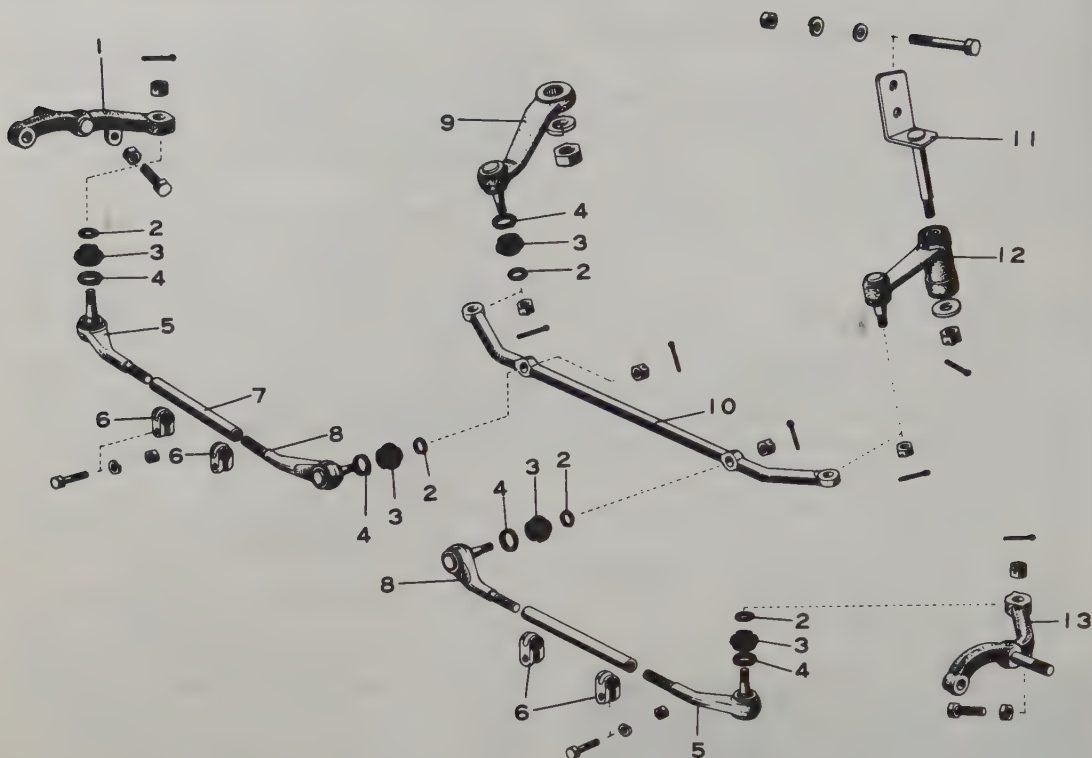
4-Wheel Drive

1. Remove the shimmy dampner from the tie rod and axle housing.

2. Remove the tie rod from the knuckle arm.

3. Remove the drag link from the steering knuckle arm.

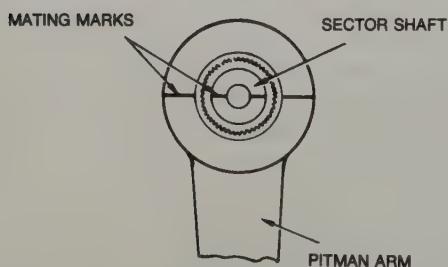
4. Remove the pitman arm.



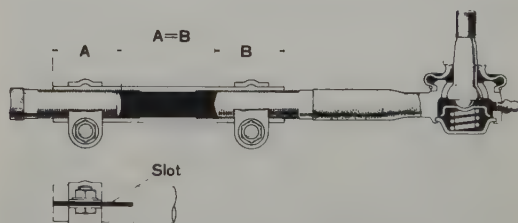
1. Steering knuckle arm No. 1
2. Ring
3. Steering link joint dust seal
4. Set ring
5. Tie-rod end subassembly No. 1
6. Tie-rod end clamp
7. Tie-rod adjusting tube

8. Tie-rod end subassembly No. 2
9. Pitman arm subassembly
10. Steering relay rod
11. Idle arm support subassembly
12. Steering idler arm subassembly
13. Steering knuckle arm No. 2

Right hand drive steering linkage. U.S. models have pitman and idler arms reversed



Aligning the mating marks on the pitman arm and the sector shaft



Adjust the tie-rod ends equally within the tube, and the clamp bolt at the tube slot

NOTE: For the above procedures you will need a two pronged puller.

5. Installation is the reverse of removal.

NOTE: When replacing the pitman arm make sure to align the matchmarks on the pitman arm and sector shaft. Tighten the drag link plug, then loosen $1\frac{1}{2}$ Turns. Also remember to grease the drag link.

Tightening specifications.

Tie rod 55-79 ft. lb.

Shimmy Dampner 37-50 ft. lb.

Tie rod clamp 15-21 ft. lb.

CAUTION: The shimmy dampner bolt must be facing toward the front.

Shimmy dampner nut (axle end) 8-11 ft. lb.

Tie Rod

REMOVAL AND INSTALLATION

4 x 4 Only

1. Jack up your vehicle and place jack stands under the front rear housing.

2. Disconnect the shimmy dampner from the tie rod.

3. Disconnect the tie rod from the steering knuckle on both sides.

NOTE: *Place match marks on the adjusting bar and tie rod ends before disassembly of this rod.*

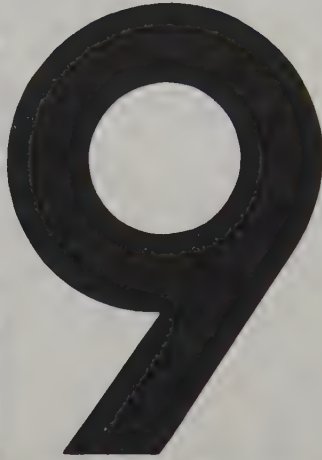
4. Remove the tie rod from the vehicle.

5. Place the tie rod in a vise and loosen the adjusting bolts.

6. Remove both rod ends.

7. Installation is the reverse of removal. Tighten the tie rod ends 55–79 ft. lb., adjusting bolts 15–21 ft. lb. Shimmy dampner 37–50 ft. lb.

Brakes



Drum type hydraulic brakes are used on all four wheels from 1970-74. The front brakes have a dual wheel cylinder design, while the rear brakes use a single wheel cylinder acting on both shoes. Both front and rear drum brakes require periodic adjustment.

Since 1975 all trucks have been equipped with front disc brakes. These are dual piston fixed caliper brakes, and are self-adjusting. The rear duo-servo drum brakes were modified in 1975 to include a self-adjusting unit which is activated upon brake application whenever the truck is backing up. These rear brakes require manual adjustment only when the brake shoes are replaced.

The split hydraulic system is equipped with a tandem master cylinder, which ensures separate braking power to the front and rear wheels. If a failure should occur in one system, the other will remain unaffected. The system is vacuum boosted on all trucks.

The parking brake is mechanically connected by cable to the rear brakes, and therefore is completely independent of the hydraulic brake system.

Most repairs on the brake system can be accomplished without special tools; however, if you plan to do extensive work, it would be advisable to purchase a good bleeder screw wrench and several flare nut wrenches.

These will prevent damage to the compression fittings on the hydraulic system.

NOTE: The brake system is the single most important safety item of the vehicle. All repairs must be carried out with extreme care. Failure of the brake system could prove disastrous.

BRAKE SYSTEM

Adjustment

Front (1970-74)

The front wheels are equipped with two wheel cylinders and two sets of adjusters. Each brake shoe must be adjusted separately to achieve the correct adjustment. The procedure outlined is for the adjustment of one shoe; repeat the procedure on all four shoes of the front wheel brakes.

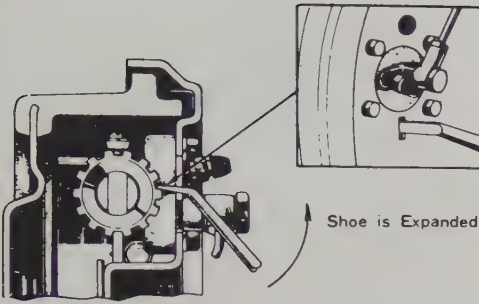
1. Jack up the front end of the truck and support the crossmember with jackstands.

CAUTION: You will be working under the truck so be absolutely certain that it is firmly supported.

2. Remove the adjusting hole plug from the backing plate.

3. Expand the brake shoe with a starwheel adjusting wrench or a screwdriver.

4. Pump the brake pedal several times while doing this to center the brake shoe.



Adjusting brake shoe clearance

NOTE: Continue to expand the shoe until the wheel will not turn when the pedal is released.

5. Back off the adjuster just enough so that the wheel will turn with a slight drag. Then back off the adjuster another five notches. The wheel should turn smoothly.

6. If the wheel does not turn smoothly, back off one or two more notches. If the wheel is still dragging, check for worn or defective parts.

7. Pump the brake pedal again to center the shoe.

8. Proceed to the next shoe and repeat the procedure.

(1975 and Later)

Front disc brakes require no adjustment, as hydraulic pressure maintains proper pad-to-disc clearance.

Rear (All)

NOTE: This procedure is necessary on 1975 and later self-adjusting brakes only after the brake shoes have been changed.

1. Place blocks under the front wheels so that the truck will not roll forward when it is jacked up at the rear.

2. Fully release the emergency brake.

3. Jack up the rear end of the truck and support the differential housing with jackstands.

4. Remove the plug from the adjusting hole at the bottom of the backing plate.

NOTE: Unlike the front wheels, the rear brakes have only one wheel cylinder and therefore both shoes on the wheel are adjusted at the same time.

5. Turn the adjusting starwheel to expand the shoes fully. While doing this, step on the brake pedal occasionally to center the shoes.

6. Tighten the shoes until the wheel will not turn when you release the brake pedal.

7. From this position back off the adjuster

until the wheel turns with just a slight drag.

8. Back off the adjuster an additional five notches. The wheel should turn smoothly. If it does not, back off another two or three notches. Should this fail, check for worn or defective parts.

9. Adjust the other wheel in the same manner.

MASTER CYLINDER

REMOVAL AND INSTALLATION

1. Remove the hydraulic lines from the master cylinder. Be careful not to damage the nuts on the compression fittings. On 1970–72 models, also disconnect the brake fluid hoses from the reservoir at the master cylinder.

CAUTION: Brake fluid will ruin paint. Avoid getting it on the body.

2. Detach the brake fluid warning switch wiring.

3. Remove the bolts attaching the master cylinder to the booster unit.

The installation of the unit is performed in the reverse order. Screw the hydraulic lines into the cylinder a few turns before bolting the unit to the booster assembly. After installation, bleed the system.

NOTE: To accurately install the master cylinder the clearance between the booster piston rod and the master cylinder piston should be 0.12–0.24 in. This can be done after the master cylinder is installed. The brake pedal should move the specified distance with just a slight touch. Remember, you are only checking the distance in which the rod is traveling to contact the piston, not to depress it. See the Brake Pedal Adjustment section in this Chapter.

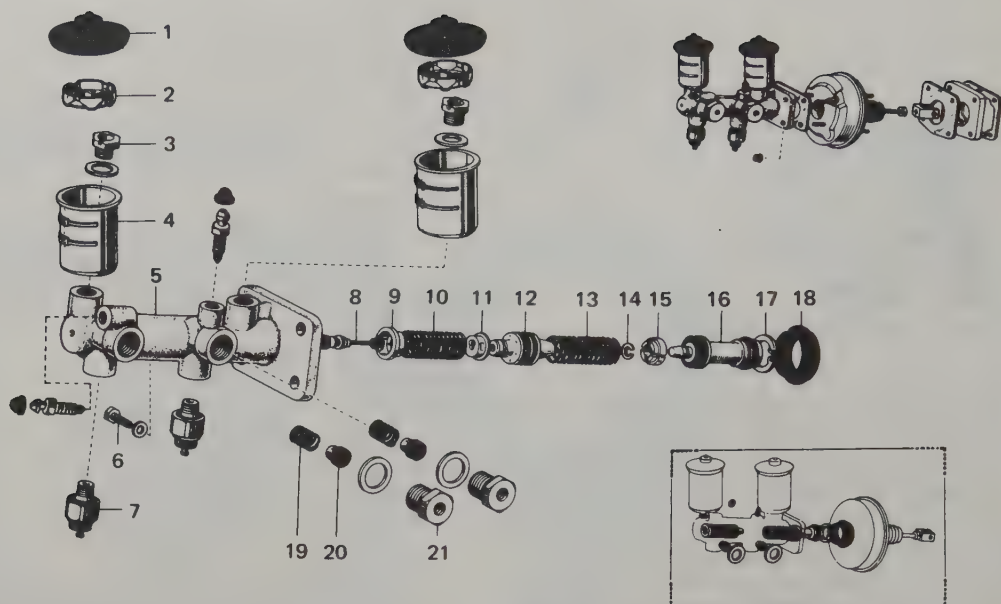
OVERHAUL

1. On all 1973 and later models, remove the reservoir caps, floats, and strainers. Remove the reservoir mounting bolts and the reservoirs, being careful not to damage the rubber rings beneath them. On 1970–72 models, remove the two reservoir hose fittings and washers.

2. Unbolt the pressure warning switches.

3. Remove the bolt and gasket from the side of the cylinder.

4. Remove the boot and snap ring from the rear of the cylinder, then remove piston #1, the compression spring, piston #2, spring, and the inlet valve seat and rod.



- | | |
|---|---|
| 1. Reservoir filler cap subassembly | 12. Master cylinder piston No. 2 |
| 2. Master cylinder reservoir strainer | 13. Compression spring |
| 3. Master cylinder reservoir set bolt | 14. Shaft snap-ring |
| 4. Master cylinder reservoir | 15. Piston return spring retainer |
| 5. Tandem master cylinder body | 16. Master cylinder piston No. 1 |
| 6. Bolt | 17. Hole snap-ring |
| 7. Brake warning switch assembly | 18. Master cylinder boot |
| 8. Inlet valve connecting rod | 19. Compression spring |
| 9. Inlet valve case | 20. Master cylinder outlet check valve assembly |
| 10. Compression spring | 21. Master cylinder fluid outlet plug |
| 11. Piston return spring retainer No. 2 | |

1973-74 master cylinder—exploded view

5. Remove the outlet plugs, gaskets, check valves, and springs from the side of the cylinder.

6. Wash all the parts in brake fluid and allow to air dry. Inspect the cylinder bore and piston surfaces for wear and concentricity. The cylinder may be honed slightly if necessary, but the piston-to-cylinder clearance limit is 0.006 in.

7. Rubber parts deteriorate over time, and disassembly usually causes them to deform. Therefore, all rubber parts should be replaced. They are available as a kit from your dealer. Wash them in brake fluid before use.

8. Replace the parts in reverse order of removal. All parts must be absolutely clean. Lubricate all the parts with brake fluid before assembly.

9. Tighten the outlet plugs over the gaskets, check valves, and springs, to 80-95 ft. lbs. Tighten the warning switches to 22-30 ft. lbs. On 1973 and later models, tighten the master cylinder reservoirs to 14-22 ft. lbs., making certain that the markings are towards

the front. The front reservoir is the larger of the two on 1975 and later models.

10. After installation, bleed the master cylinder and check all lines for leaks. Adjust the brake pedal clearance if necessary.

Brake Booster

REMOVAL AND INSTALLATION

1. Remove the master cylinder.
2. Remove the clip and clevis pin from the brake pedal.
3. Remove the vacuum hose from the booster.
4. Remove the brake booster nuts and gaskets, and remove the booster.

NOTE: *The 4x4 has two extra brackets that must be removed when removing the brake booster.*

Load Sensing Proportioning Valve

The purpose of this valve is to control the fluid pressure applied to the brakes to pre-

vent rear wheel lock-up during weight transfer at high speed stops.

REMOVAL AND INSTALLATION

1. Disconnect the brake lines going to the valve.

2. Remove the mounting bolt, if used, and remove the valve.

NOTE: *This valve can not be rebuilt. It must be replaced.*

3. Installation is the reverse of removal.

4. Bleed the brake system.

ADJUSTMENT

1. Pull down the load sensing spring to determine that the piston moves slowly.

2. Set the valve body so that the piston lightly touches the load sensing spring.

3. Tighten the mounting bolts.

BLEEDING

CAUTION: *Never reuse brake fluid which has been bled from the brake system.*

1. On 1973-74 models, if the master cylinder has been overhauled, start the bleeding procedure with the master cylinder. On all other models (and after bleeding the master cylinder on 1973-74s) start with the wheel cylinder farthest from the master cylinder (right rear) and work toward it.

2. Clean the bleeder screw at each wheel.

3. Fill the master cylinder with DOT 3 brake fluid.

NOTE: *Brake fluid picks up moisture from the air. Don't leave the master cylinder or the fluid container uncovered any longer than necessary. Be careful-brake fluid eats paint.*

Check the level of the fluid often when bleeding, and refill the reservoirs as necessary. Don't let them run dry, or you will have to repeat the process.

4. Attach a length of clear vinyl tubing to the bleeder screw on the wheel cylinder (or

master cylinder). Insert the other end of the tube into a clear, clean jar half filled with brake fluid.

5. Have your helper slowly depress the brake pedal. As this is done, open the bleeder screw $\frac{1}{8}$ - $\frac{1}{2}$ of a turn, and allow the fluid to run through the tube. Then close the bleeder screw before the pedal reaches the end of its travel. Have your assistant slowly release the pedal. Repeat this process until no air bubbles appear in the expelled fluid.

NOTE: *If the brake pedal is depressed too fast, small air bubbles will form in the brake fluid.*

6. Repeat the procedure on the other three brakes, checking the level of fluid in the cylinder reservoirs often.

Brake Pedal adjustment

There are two adjustments possible on the brake pedal: pedal height and master cylinder piston/pushrod clearance.

1. To adjust the distance between the pedal and the toeboard, loosen the locknut on the tail light stop switch and adjust the pedal to a height of 6.18-6.57 in. above the toeboard by turning the switch body.

NOTE: *If the pedal cannot be adjusted properly with the switch body, loosen the pushrod locknut and turn the pushrod.*

2. After adjusting the pedal, tighten the stop switch locknut.

3. Loosen the pushrod locknut and turn the pushrod to provide 0.12-0.24 in. clearance between the master cylinder piston and the pushrod.

4. After tightening the pushrod locknut, check to see that the pedal has about $2\frac{1}{2}$ in. of reserve travel when depressed.

5. Check the brake light (tail light) operation after all adjustments have been made.

FRONT DRUM BRAKES

Brake Drums

REMOVAL AND INSTALLATION

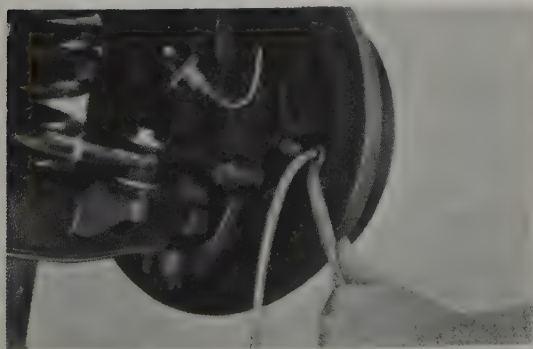
1. Remove the hub cap and loosen the lug nuts.

2. Raise the front of the vehicle and support it on jackstands.

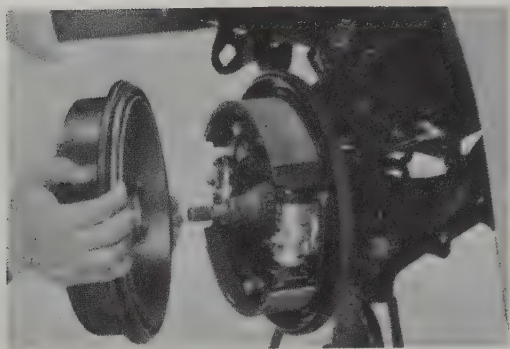
3. Remove the lug nuts, tire and wheel.

4. Remove the axle hub grease cap.

5. Remove the cotter pin and then loosen the hub nut. When the nut is close to the end of the spindle, pull the drum and hub assem-



Air bleeding the wheel cylinder



Removing the front brake drum

bly toward you. If it does not slide off the brake shoes, loosen the brake shoe adjuster starwheels. Remove the spindle nut, brake drum and hub, the washer, and the wheel bearings.

NOTE: *Be careful not to get foreign matter in the wheel bearings. The heavy coating of grease will hold many particles. These will damage the bearings.*

6. Inspect the brake drum as outlined below.

CAUTION: *Do not depress the brake pedal with the drum removed.*

7. Install the drum in the reverse order. For instructions on preloading the front wheel bearings, see the appropriate section in Chapter 1.

INSPECTION

1. Clean the drum with a rag and a little paint thinner.

CAUTION: *Do not blow the brake dust out of the drum with compressed air or lung power. Brake linings contain asbestos, a known cancer-causing agent.*

2. Inspect the drum for cracks, grooves, scoring and out-of-roundness.

3. Light scoring may be removed with fine emery paper. Heavy scoring or grooves will have to be removed by having the drum turned on a lathe. This can be done at many automotive machine shops and some service stations.

4. Before cutting the drum it must be measured to determine whether or not the inside dimension of the drum is within limitations after removing the score marks. The service limits of the brake drums are as follows:

1970-71 9 inch drum—9.134 in.

1972 and later 10 inch drum—10.08 in.

5. Check the drum for concentricity. An

inside micrometer is necessary for an exact measurement, so unless this tool is available, the drum should be taken to a machine shop to be checked. Any drum which measures more than 0.006 in. out of round will result in an inaccurate brake adjustment and other problems, and must be refinished or replaced.

NOTE: *Make all measurements at right angles to each other and at the open and closed edges of the drum machined surface.*

Brake Shoes

1. Remove the brake drum.

2. Remove the long brake tension (retracting) springs. These have hooks on each end, but you should be able to get them off with a pair of needlenose pliers. Remove the hold down springs with a brake tool. You can make do with some other tool, but it isn't easy. Pull out the spring pin from the rear, and remove the shoes.

NOTE: *If the brake shoes are to be reused, mark them so that they may be returned to their original locations.*

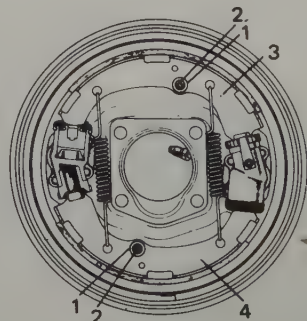
3. Clean the backing plate with a wire brush.

4. Inspect the brake springs for deformation and weakness, replace any parts found to be defective.

5. Check the brake linings for wear. The factory limit is 0.04 in. measured at both ends and middle of the shoe. If the limit is exceeded, replace both brake shoes.

NOTE: *This measurement may disagree with your state inspection laws.*

6. Check to see that no grease or brake fluid is leaking onto the backing plate or the



1. Hold down spring

2. Spring pin

3. Upper brake shoe

4. Lower brake shoe

Remove these parts in the order shown here, after removing the long shoe tension springs

shoes. Fresh grease on the backing plate may indicate a faulty seal in the hub. Brake fluid leakage can be traced to the wheel cylinder or brake line. If there is any leakage, rebuild the wheel cylinders or replace the brake lines. **DO NOT DELAY**, as a brake failure could result.

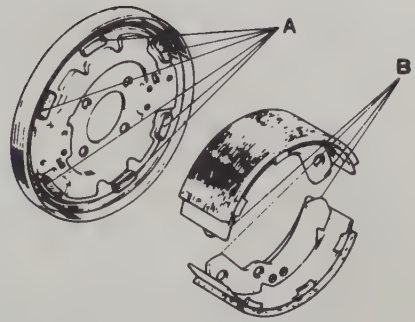
NOTE: A small trace of fluid may be present to act as a lubricant for the wheel cylinder pistons.

7. Before proceeding to the installation of the brake shoes, coat all the points of contact on the backing plate with a film of multipurpose grease.

CAUTION: Do not get grease or oil on the brake shoes.

Install the shoes in the following manner:

1. Fit the upper and lower shoes onto the grooves on the wheel cylinders and adjusting bolts. Install the spring pins and the retaining springs with the aid of a brake spring tool.
2. Hook the brake shoe tension springs on the upper and lower shoes.



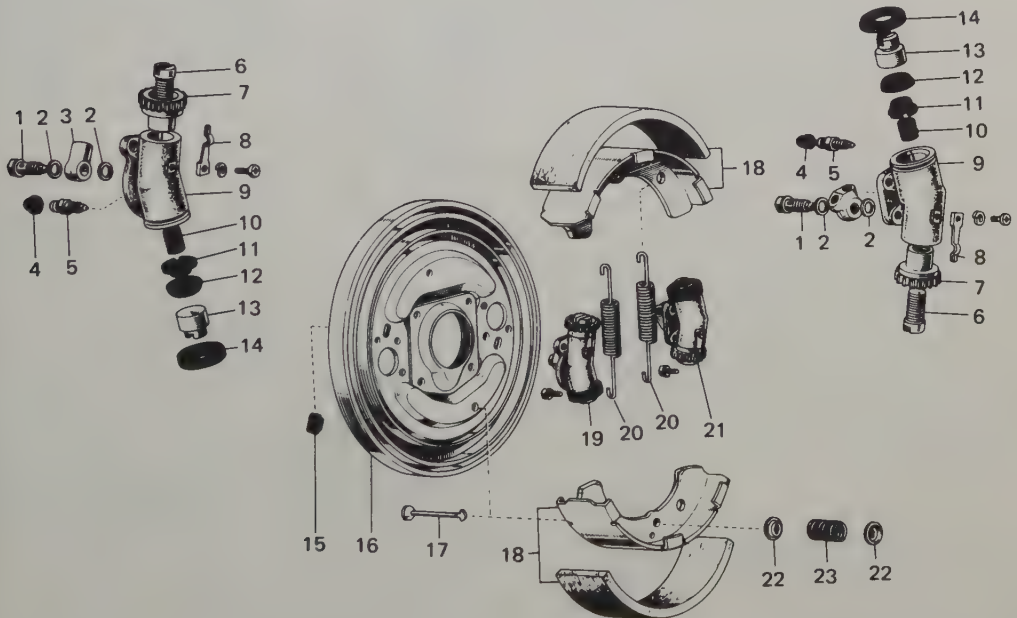
Lightly coat points A and B with grease

3. Install the drum and adjust the brakes as outlined earlier.

Wheel Cylinders

REMOVAL AND INSTALLATION

1. Perform the brake drum and brake shoe removal procedures, as outlined above.
2. Plug the master cylinder reservoir inlet, to prevent fluid from leaking out.



1. Union bolt
2. Gasket
3. Union
4. Bleeder plug cap
5. Bleeder plug
6. Wheel cylinder adjusting bolt
7. Wheel cylinder adjusting nut
8. Adjuster lock spring
9. Front brake wheel cylinder body
10. Compression spring
11. Wheel cylinder piston spring seat
12. Cylinder cup

13. Wheel brake cylinder piston
14. Wheel cylinder boot
15. Shoe adjusting hole plug
16. Brake backing front plate subassembly
17. Shoe hold-down spring pin
18. Brake shoe assembly
19. Front brake No. 1 wheel cylinder assembly
20. Tension spring
21. Front brake No. 2 wheel cylinder assembly
22. Shoe hold-down spring cup
23. Spring

Front brake components—1970-74

3. Remove the hydraulic lines from the wheel cylinders by unfastening the union bolt.

4. Remove the wheel cylinder attachment screws and remove the wheel cylinders.

CAUTION: *Do not mix the right and left wheel cylinders.*

To install the wheel cylinders, proceed in the following manner:

1. Use the attaching screws to install the wheel cylinder to the backing plate.

NOTE: *The wheel cylinder adjusting nut and bolt on the right-side of the brake have left-hand threads; while those on the left side have right-hand threads. Be careful not to mix them.*

2. Connect the hydraulic lines to the wheel cylinders.

CAUTION: *Use care to ensure that the hydraulic line is not twisted.*

3. Install the brake drum and shoes, as outlined above. Bleed the brake system.

OVERHAUL

Remove the boots, pistons and the cups and closely inspect the bores for signs of wear, scoring and/or scuffing. When in doubt, replace or hone the wheel cylinders with a special brake hone, using clean brake fluid as lubricant. Wash residue from the bores using clean fluid; never use oil or any other solvent on any brake components. Blow dry with air and install with fresh brake fluid. The general limit for a honed cylinder is 0.005 in. over-size. Wheel cylinder rebuilding kits are available which include new boots and cups. Never reuse these parts. The adjuster screws should be taken apart and all dirt and rust removed with a wire brush. Lightly coat with Lubriplate before assembly; components should turn freely.

FRONT DISC BRAKES

Brake Pads

REMOVAL AND INSTALLATION

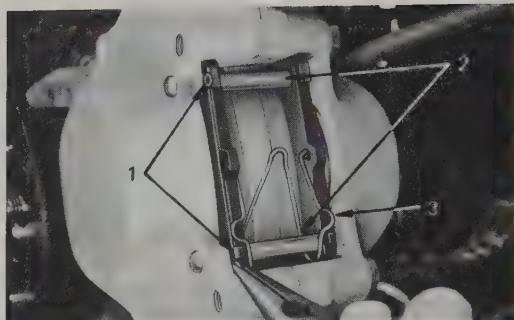
The front pads must be removed for wear inspection. It is not necessary to remove the caliper.

1. Jack up the front of the truck, support it on jackstands, and remove the front wheel.

2. Pull out the two wire clips at the ends of the pad pins.

3. Pull out the pads and anti-squeal shims.

4. Check the pad thickness and replace



Remove the pin clips (1), pins (2) and anti-rattle spring (3) to get at the pads

the pads if they are less than 0.04 in. thick. New pads measure approximately 0.38 in. thick.

NOTE: *This minimum thickness measurement may disagree with your state inspection laws.*

5. Check the pins for straightness and wear, and replace if necessary.

6. To install, position the anti-squeal shims so that the folded part will face the pad, and the arrows will face the direction of forward rotation. Lightly coat both sides of the shims with anti-squeak lubricant before installation.

7. Install the shims and pads.

8. Install the anti-rattle spring, the pad pins, and the pin clips.

Caliper

REMOVAL AND INSTALLATION

2-Wheel Drive

1. Perform the first three steps of the pad removal procedure.

2. Plug the vent hole on the master cylinder cap to prevent fluid leakage. Unbolt the brake line from the caliper, being careful not to deform the fittings.

3. Remove the two caliper mounting bolts, and remove the caliper.

4. To install, reverse the procedure. Tighten the caliper mounting bolts to 67–87 ft. lbs. Be certain to position the shims correctly, and bleed the system after all parts are installed.

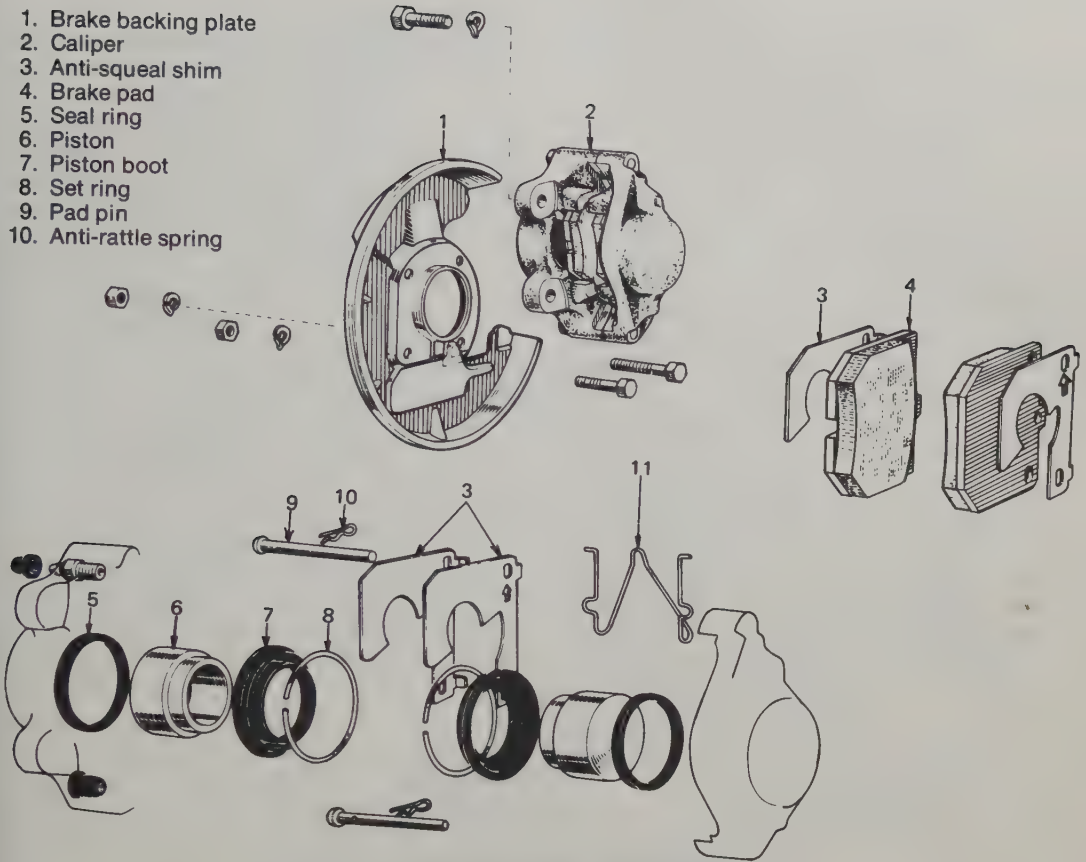
OVERHAUL

1. Remove the caliper.

2. Remove the set ring and the piston boot from the caliper.

3. Place a thin wooden slat between the

1. Brake backing plate
2. Caliper
3. Anti-squeal shim
4. Brake pad
5. Seal ring
6. Piston
7. Piston boot
8. Set ring
9. Pad pin
10. Anti-rattle spring



2-wheel drive caliper components

pistons. Remove the pistons by blowing compressed air through the brake line hole.

4. Remove the seal rings from the piston seat.

CAUTION: Do not loosen the four bolts holding the two halves of the caliper together.

5. Inspect the caliper for cracks or deformation. Check the piston bores and pistons for wear, scoring, and corrosion. Replace any worn or defective parts.

6. To assemble, coat the piston walls and seal rings with rubber grease. Insert the rings into the piston seats.

7. Coat the pistons with rubber grease and push them into the bores.

8. Install the piston boots, and replace the set rings.

9. Install the caliper, and bleed the system.

4-Wheel Drive S-12+8 Type

1. Disconnect the brake line.

2. Unbolt the caliper from the backer plate.

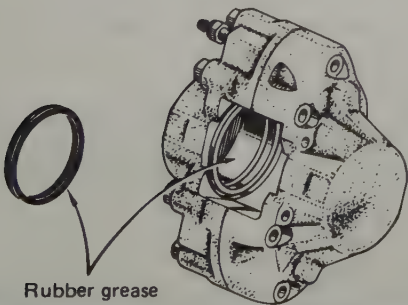
3. Insert a thin piece of wood in the caliper.

4. Apply compressed air to one piston at a time through the brake line hole.

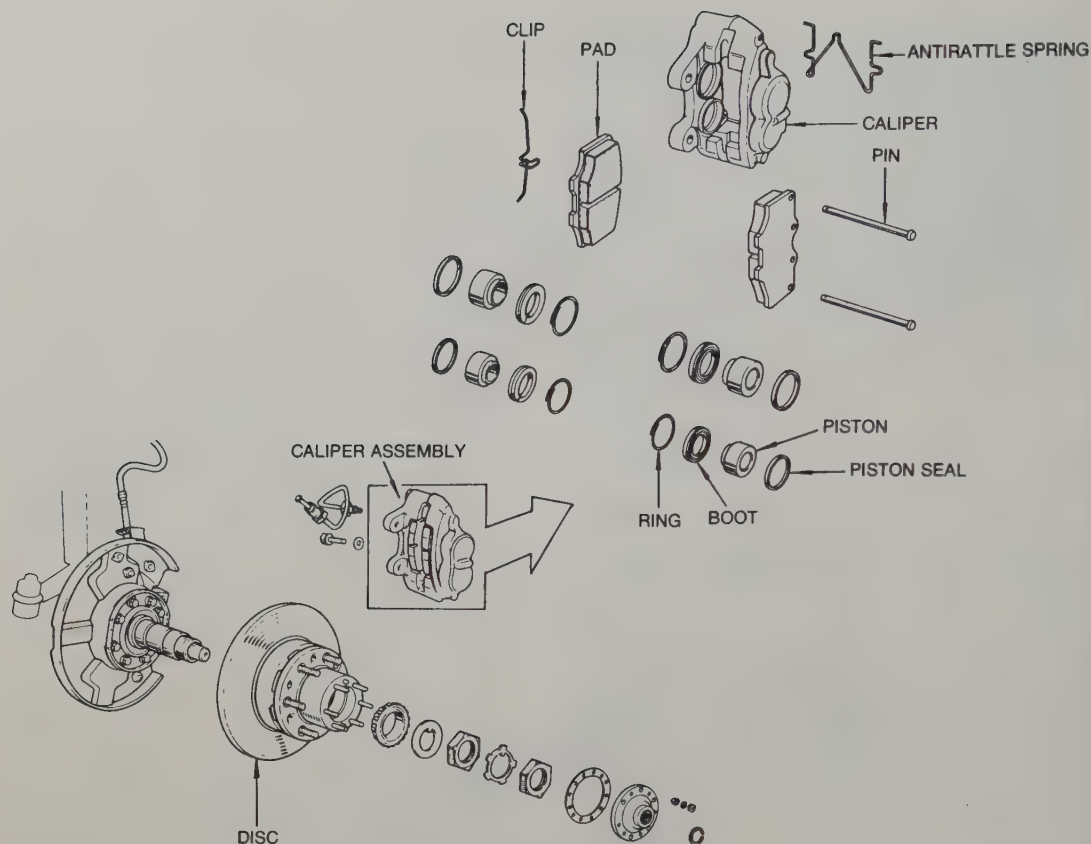
CAUTION: Don't loosen the caliper bolts or separate the caliper.

5. Inspect the pistons for wear or damage. Replace the parts if necessary.

NOTE: Clean the piston and cylinder with brake fluid. Do not reuse the piston ring and cylinder boot.



Coat the seal rings and the piston bores with rubber grease



S-12-8 type disc brake (4 x 4)

6. Check the disc for thickness. Standard 0.49 in. Limit 0.45 in. This must be done with a caliper.

7. Check the disc run-out. Limit 0.006 in.

NOTE: Before checking disc run-out, check the wheel bearing looseness. You will need a dial indicator to check disc run-out.

8. Apply rubber grease to the new seal and piston.

9. Do not pry the piston into the cylinder.

10. Apply disc brake grease on the cylinder that the pads slide on.

11. Install the pads.

12. Install the anti-rattle spring, caliper pins and pin clip.

13. Tighten the caliper bolts 55–75 ft. lbs.

14. Connect the brake line to the caliper; 10–13 ft. lbs.

15. Bleed the system.

16. Refill the master cylinder to the maximum line.

Disc

REMOVAL AND INSTALLATION

1. Remove the brake caliper as outlined earlier.

2. Remove the grease cap, cotter pin, adjusting cap and nut.

3. Pull the axle hub and attached disc toward you off the spindle. Be careful not to drop the outer bearing, inside the hub.

4. Do not separate the hub and disc unless the disc is to be refinished or replaced. The disc is held to the hub by four bolts. They must be torqued to 29–40 ft. lbs. upon reassembly.

5. To install, follow Steps 8–12 of the Wheel Bearing Adjustment and Lubrication procedure, and the Preload Adjustment procedure in Chapter 1.

INSPECTION

The disc does not need to be removed for inspection. Run-out can be checked with a dial

indicator, and should measure less than 0.0059 in. Disc thickness, measured with a caliper, must be at least 0.453 in. The standard disc thickness is 0.492 in.

Inspect the disc for scoring or corrosion. If it is scored, it should be taken to a shop for refinishing, bearing in mind that it must measure more than 0.453 in. thick when all marks have been removed. Run-out can sometimes be corrected by refinishing.

WHEEL BEARINGS

Wheel bearing removal, installation, and adjustment is covered in Chapter 1.

REAR BRAKES

Non self-adjusting brakes were used from 1970–74. Adjustments are covered at the beginning of this Chapter. Self-adjusting brakes were introduced in 1975. Procedures are combined for the two systems in this section for drum removal, installation, and inspection, and brake shoe removal.

Brake Drum

REMOVAL AND INSTALLATION

1. Block the front wheels so that the truck cannot roll forward.

2. Raise the rear of the truck and support it on jackstands.

3. Remove the wheel and tire.

4. Fully release the emergency brake.

NOTE: *Be absolutely certain that the emergency brake is released completely.*

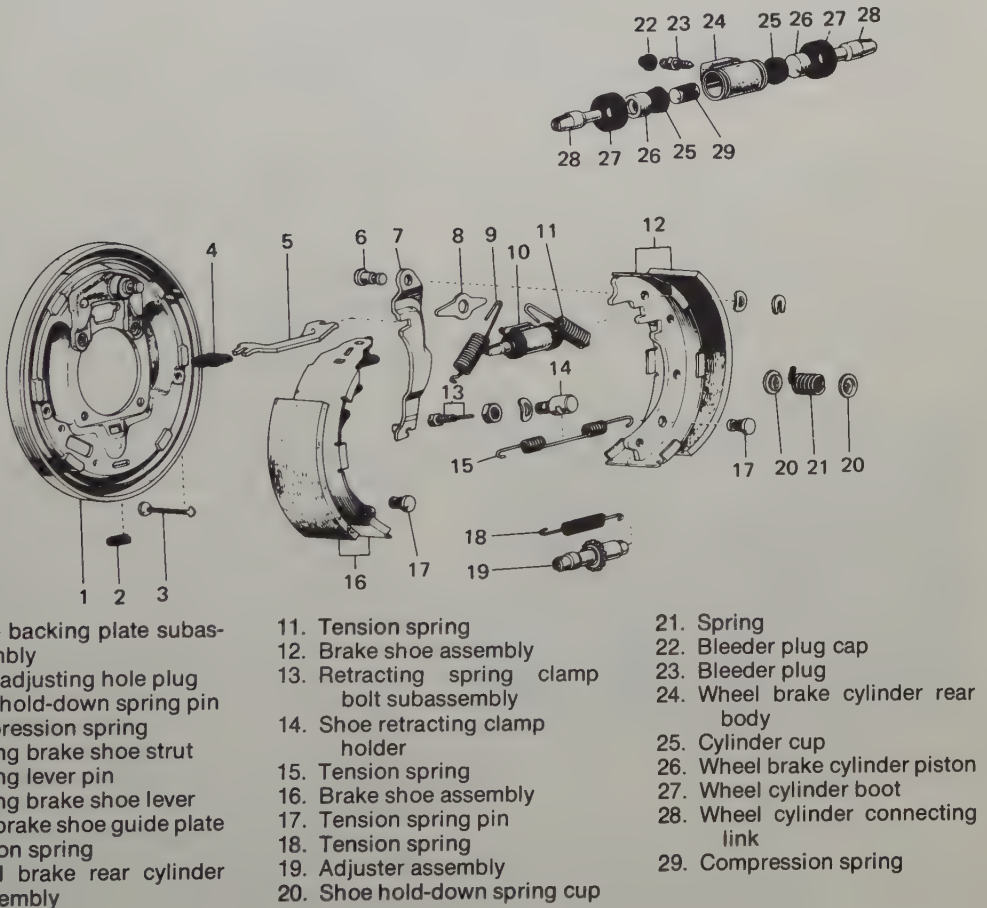
5. Unfasten the brake drum retaining screw and remove the screw from the drum.

6. Tap the drum with a soft mallet and remove the drum. If the drum does not come off, back off the starwheel adjuster for the brake shoes.

NOTE: *Do not strike the brake drum with a regular hammer.*

7. To install the drum simply replace the drum on the axle and tighten the retaining screw.

NOTE: *Don't forget to adjust the brake shoes.*



Rear brake components—1970–74

CAUTION: *Do not step on the brake pedal with the drum removed.*

INSPECTION

The inspection procedure and measurements are the same for the rear drums as for the front drums and linings. See the appropriate section in this chapter.

Brake Shoes

REMOVAL AND INSTALLATION

1. Remove the drum as outlined earlier.
2. Loosen the retracting spring clamp bolt on non self-adjusting brakes. On self-adjusters, remove the adjusting spring and lever at the bottom.
3. Using a brake spring tool, remove the return springs. On self-adjusters, also remove the adjusting cable, shoe guide plate, and the cable guide.
4. Remove the hold-down springs and the hold-down spring pins. On self-adjusters, first remove the parking brake shoe strut and spring, and the lower retracting spring and adjusting screw set. Then remove the hold down springs and pins.
5. Remove the parking brake shoe strut along with the spring on non self-adjusters only.
6. Grip the brake shoes at the top near the wheel cylinder, spread the shoes apart and draw the shoes, adjusting mechanism, and spring away from the backing plate. On self-adjusters, simply remove the brake shoes, as there should be no spring tension left. If the shoes are hard to remove, check for an unre-moved part.



Removing the horseshoe clip and the parking brake shoe lever

7. Remove the rear shoe and the parking brake shoe lever from the parking brake cable.

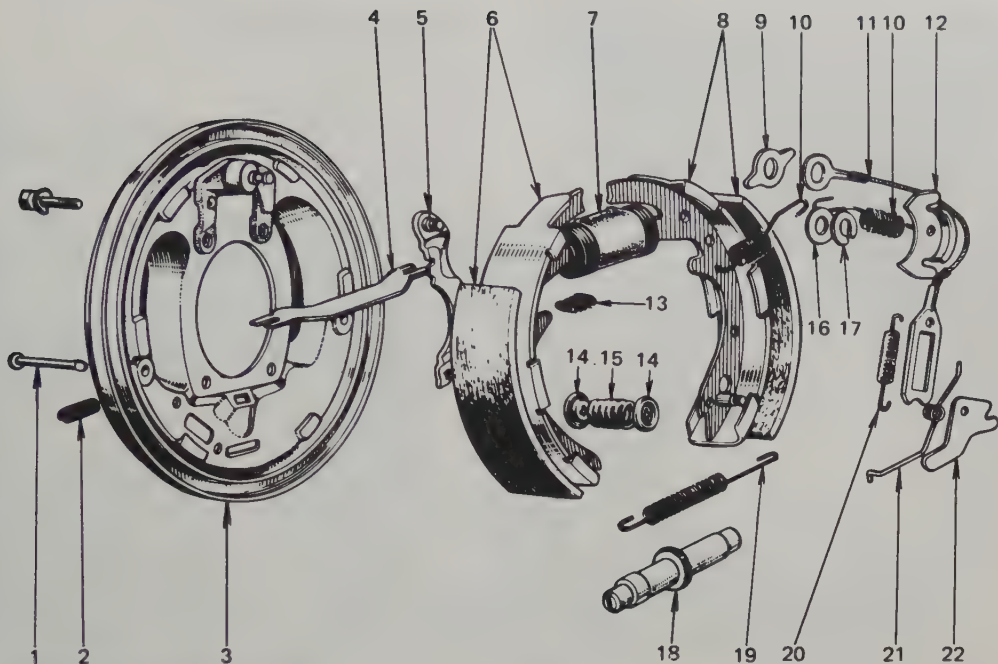
8. Remove the shoe lever from the shoe by removing the horseshoe clip from the pin.
To install new shoes proceed as follows:

Non Self-Adjusting

1. Assemble the rear shoe to the parking brake shoe lever, install a new clip.
NOTE: *Coat all contact points for the shoes and the parking brake mechanism with grease.*
CAUTION: *Do not get grease on the linings or the inside of the brake drum.*
2. Assemble the adjusting mechanism between the shoes and install the adjusting spring. The adjuster with left-hand threads goes on the left wheel, right-hand threads on the right wheel. Install the shoes onto the wheel cylinder and backing plate.
3. Install the hold-down pins and springs.
4. Install the parking brake strut arm and make the necessary connection of the emergency brake cable.
5. Install the return springs.
6. Install the brake drum and adjust the brake shoes.

Self-Adjusting

1. Assemble the parking brake shoe lever and brake shoe.
2. Connect the parking brake shoe lever to the parking brake cable.
3. Apply a thin coat of grease to the backing plate and shoe contacting surfaces, and anchor pin and shoe end surfaces. Install the brake shoes, shorter lining shoe on the front, and the hold down springs and pins.
4. Install the spring onto the front of the parking brake shoe strut, and install the strut between the brake shoes.
5. Fit the shoe guide plate and automatic adjusting cable onto the anchor pin, and using a brake tool install the brake shoe return spring to the front side.
6. Apply a thin coat of grease to the cable guide sliding surface, and fit the cable guide to the rear shoe. Install the return spring to the rear shoe with a brake tool.
7. Install the adjusting screw set, right-hand threads on the right wheel, left-hand threads on the left wheel. Apply a coat of grease to the threads, washer, and slots.
NOTE: *Make sure that the threaded portion faces the front.*
8. Install the brake shoe retracting spring at the bottom, longer hook to the rear shoe.
9. Hook the adjusting lever to the adjusting cable spring. Insert the lever slot onto



1. Shoe hold down spring pin

2. Adjusting hole plug

3. Backing plate

4. Parking brake shoe strut

5. Parking brake shoe lever

6. Front brake shoe

7. Wheel cylinder

8. Rear brake shoe
9. Shoe guide plate

10. Return spring

11. Automatic adjuster cable

12. Cable guide

13. Parking brake strut spring

14. Hold down spring seat

15. Shoe hold down spring

16. Washer
17. C washer

18. Adjusting screw set

19. Retracting spring

20. Adjusting cable spring

21. Adjusting lever spring

22. Adjusting lever

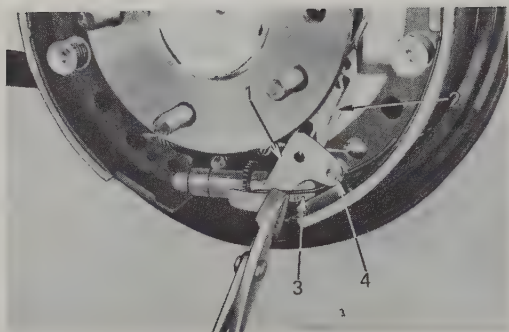
1975 and later self-adjusting brake components

Brake Specifications

All measurements given are (in.) unless noted

Year	Model	Lug Nut Torque (ft/lb)	Master Cylinder Bore	Brake Disc		Brake Drum			Minimum Lining Thickness	
				Minimum Thickness	Maximum Run-Out	Diameter	Max. Machine O/S	Max. Wear Limit	Front	Rear
1970-72	Hi-Lux	65-86	1.001	—	—	9.1	9.13	9.15	0.06	0.06
1973-77	Hi-Lux	65-86	1.001	0.45	0.006	10.0	10.07	10.08	0.27	0.06
1978	Hi-Lux	65-86	—	0.45 ①	0.006	10.08	—	10.08	0.04	0.04
1979-80	RN	65-86	—	0.453 ②	0.0059	10.079	—	10.079	0.039	0.039
1981	RN	65-86	—	0.453 ②	0.0059	10.0 ③	—	10.079	0.039	0.039

① 0.79 in. "K" Type Disc Brake (Limit 0.75 in.)
Some 78 Hi-Lux Models have front drum brakes; Diameter 10.00 in. (limit 10.08 in.) Lining thickness 0.04 in.
② RN ½ & ¾ Ton, RN 4x4 0.453 in.—RN C+C Cab/Chassis 0.748 in.
③ Front Power Disc 10.4 in. ½ Ton—11.8 in. Power disc 4x4—9.8 in. Power disc Cab/Chassis



Hook the adjusting lever (1) to the adjusting cable spring (2), then insert the lever slot onto the pin (4) and hook up the adjusting lever spring (3)

the pivot pin, and hook the adjusting lever spring onto the end of the lever.

10. With the parts assembled, test the auto-adjust mechanism. Insert a screwdriver between the anchor pin and the rear shoe end, and move the shoe away from the pin. The adjuster should turn the adjusting screw set to expand slightly.

11. If the adjuster is OK, measure the maximum diameter of the brake drum, and adjust the shoes via the adjusting screw to be 0.012–0.024 in. smaller in diameter.

12. Install the brake drum.

Wheel Cylinders

REMOVAL AND INSTALLATION

1. Plug the master cylinder inlet to prevent hydraulic fluid from leaking.

2. Remove the brake drum and shoes.

3. Working from behind the backing plate, disconnect the brake fluid line.

4. Remove the wheel cylinder-to-backing plate attaching bolts and withdraw the wheel cylinder.

Upon reassembly be sure to bleed the system thoroughly and to readjust the brake shoes.

OVERHAUL

Overhaul procedures are the same as for the front wheel cylinders, found earlier in this Chapter.

PARKING BRAKE

ADJUSTMENT

NOTE: Before attempting to adjust the parking brake, adjust the rear brake shoes as outlined earlier.

1. Loosen the parking brake warning light switch bracket.

2. Push the parking brake lever in until it is stopped by the pawl.

3. Move the switch so that it will be “off” at this position, but “on” when the handle is pulled out.

4. Tighten the switch bracket and push the brake lever in again.

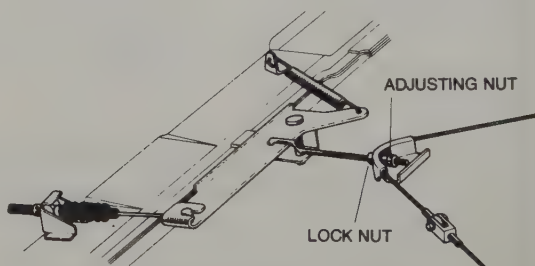
5. Working from underneath the vehicle, loosen the locknut on the parking brake cable equalizer.

6. Screw the adjusting nut *in*, just enough so that the brake cables have no slack.

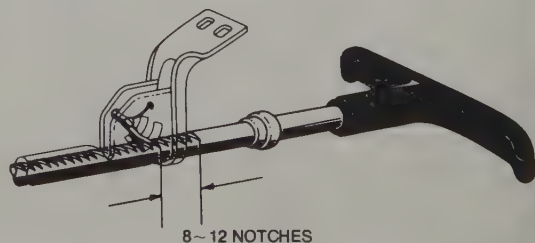
7. Hold the adjusting nut in this position while tightening the locknut.

8. Check the rotation of the rear wheels to make sure that the brakes are not dragging.

9. Pull out the parking brake lever and count the number of notches needed to apply the brake. If it is between 6 and 9 notches, the brake is properly adjusted.



Parking brake adjustment from under the truck



Parking brake handle—specified travel

Body



You can repair most minor auto body damage yourself. Minor damage usually falls into one of several categories: (1) small scratches and dings in the paint that can be repaired without the use of body filler, (2) deep scratches and dents that require body filler, but do not require pulling, or hammering metal back into shape and (3) rust-out repairs. The repair sequences illustrated in this chapter are typical of these types of repairs. If you want to get involved in more complicated repairs including pulling or hammering sheet metal back into shape, you will probably need more detailed instructions. Chilton's *Minor Auto Body Repair, 2nd Edition* is a comprehensive guide to repairing auto body damage yourself.

TOOLS AND SUPPLIES

The list of tools and equipment you may need to fix minor body damage ranges from very basic hand tools to a wide assortment of specialized body tools. Most minor scratches, dings and rust holes can be fixed using an electric drill, wire wheel or grinder attachment, half-round plastic file, sanding block, various grades of sandpaper (#36, which is coarse through #600, which is fine) in both wet and dry types, auto body plastic,

primer, touch-up paint, spreaders, newspaper and masking tape.

Most manufacturers of auto body repair products began supplying materials to professionals. Their knowledge of the best, most-used products has been translated into body repair kits for the do-it-yourselfer. Kits are available from a number of manufacturers and contain the necessary materials in the required amounts for the repair identified on the package.

Kits are available for a wide variety of uses, including:

- Rusted out metal
- All purpose kit for dents and holes
- Dents and deep scratches
- Fiberglass repair kit
- Epoxy kit for restyling.

Kits offer the advantage of buying what you need for the job. There is little waste and little chance of materials going bad from not being used. The same manufacturers also merchandise all of the individual products used—spreader, dent pullers, fiberglass cloth, polyester resin, cream hardener, body filler, body files, sandpaper, sanding discs and holders, primer, spray paint, etc.

CAUTION: Most of the products you will be using contain harmful chemicals, so be extremely careful. Always read the complete label before opening the containers. When

you put them away for future use, be sure they are out of children's reach!

Most auto body repair kits contain all the materials you need to do the job right in the kit. So, if you have a small rust spot or dent you want to fix, check the contents of the kit before you run out and buy any additional tools.

ALIGNING BODY PANELS

Doors

There are several methods of adjusting doors. Your vehicle will probably use one of those illustrated.

Whenever a door is removed and is to be reinstalled, you should matchmark the position of the hinges on the door pillars. The holes of the hinges and/or the hinge attaching points are usually oversize to permit alignment of doors. The striker plate is also moveable, through oversize holes, permitting up-and-down, in-and-out and fore-and-aft movement. Fore-and-aft movement is made by adding or subtracting shims from behind the striker and pillar post. The striker should be adjusted so that the door closes fully and remains closed, yet enters the lock freely.

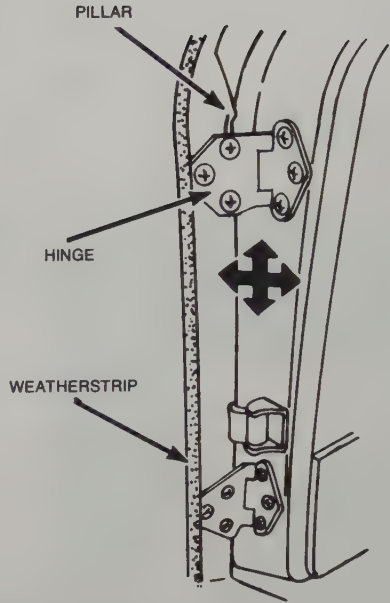
DOOR HINGES

Don't try to cover up poor door adjustment with a striker plate adjustment. The gap on each side of the door should be equal and uniform and there should be no metal-to-metal contact as the door is opened or closed.

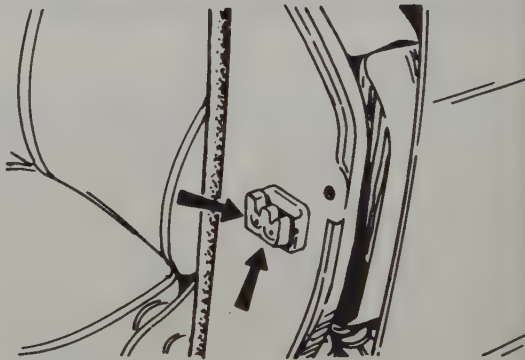
1. Determine which hinge bolts must be loosened to move the door in the desired direction.
2. Loosen the hinge bolt(s) just enough to allow the door to be moved with a padded pry bar.
3. Move the door a small amount and check the fit, after tightening the bolts. Be sure that there is no bind or interference with adjacent panels.
4. Repeat this until the door is properly positioned, and tighten all the bolts securely.

Hood, Trunk or Tailgate

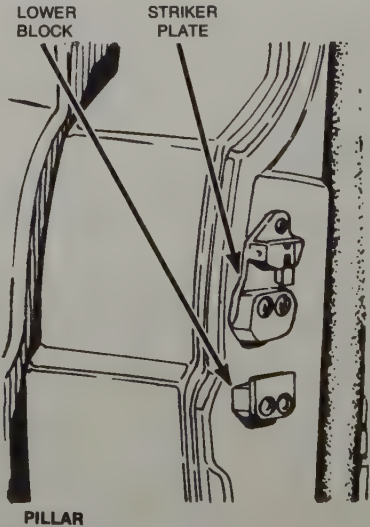
As with doors, the outline of hinges should be scribed before removal. The hood and trunk can be aligned by loosening the hinge bolts in their slotted mounting holes and moving the hood or trunk lid as necessary.



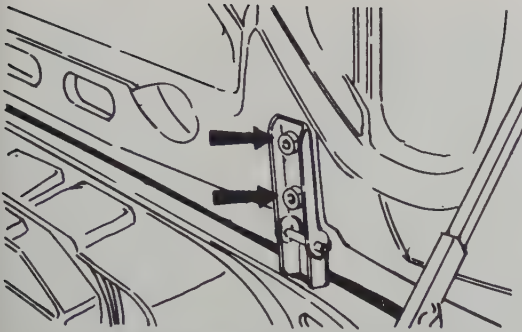
Door hinge adjustment



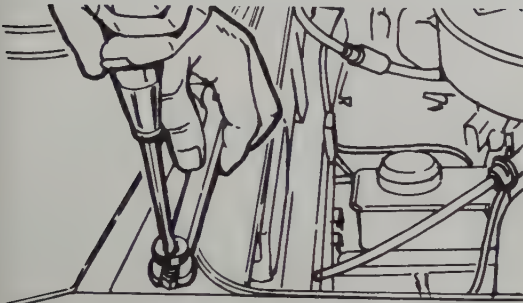
Move the door striker as indicated by arrows



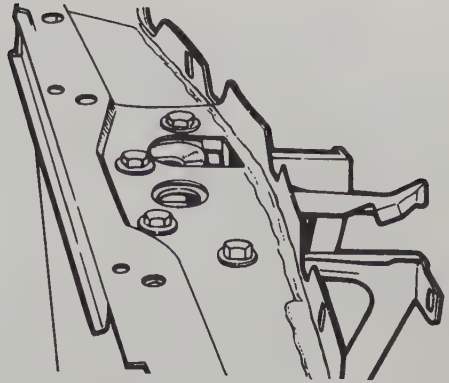
Striker plate and lower block



Loosen the hinge boots to permit fore-and-aft and horizontal adjustment



The hood is adjusted vertically by stop-screws at the front and/or rear



The base of the hood lock can also be repositioned slightly to give more positive lock engagement

The hood and trunk have adjustable catch locations to regulate lock engagement. Bumpers at the front and/or rear of the hood provide a vertical adjustment and the hood lockpin can be adjusted for proper engagement.

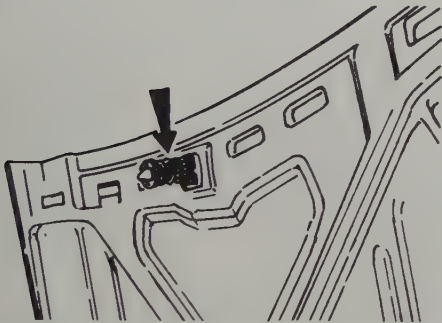
The tailgate on the station wagon can be adjusted by loosening the hinge bolts in their slotted mounting holes and moving the tailgate on its hinges. The latchplate and latch striker at the bottom of the tailgate opening can be adjusted to stop rattle. An adjustable bumper is located on each side.

RUST, UNDERCOATING, AND RUSTPROOFING

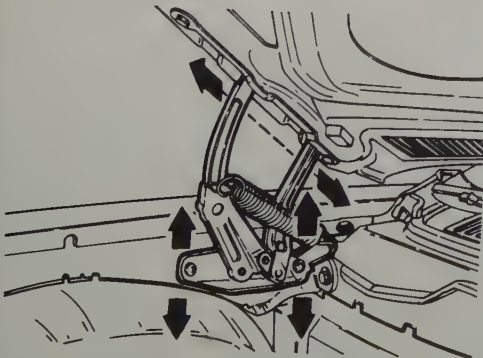
Rust

Rust is an electrochemical process. It works on ferrous metals (iron and steel) from the inside out due to exposure of unprotected surfaces to air and moisture. The possibility of rust exists practically nationwide—anywhere humidity, industrial pollution or chemical salts are present, rust can form. In coastal areas, the problem is high humidity and salt air; in snowy areas, the problem is chemical salt (de-icer) used to keep the roads clear, and in industrial areas, sulphur dioxide is present in the air from industrial pollution and is changed to sulphuric acid when it rains. The rusting process is accelerated by high temperatures, especially in snowy areas, when vehicles are driven over slushy roads and then left overnight in a heated garage.

Automotive styling also can be a contributor to rust formation. Spot welding of panels



The hood pin can be adjusted for proper lock engagement



The height of the hood at the rear is adjusted by loosening the bolts that attach the hinge to the body and moving the hood up or down

creates small pockets that trap moisture and form an environment for rust formation. Fortunately, auto manufacturers have been working hard to increase the corrosion protection of their products. Galvanized sheet metal enjoys much wider use, along with the increased use of plastic and various rust retardant coatings. Manufacturers are also designing out areas in the body where rust-forming moisture can collect.

To prevent rust, you must stop it before it gets started. On new vehicles, there are two ways to accomplish this.

First, the car or truck should be treated with a commercial rustproofing compound. There are many different brands of franchised rustproofers, but most processes involve spraying a waxy "self-healing" compound under the chassis, inside rocker panels, inside doors and fender liners and similar places where rust is likely to form. Prices for a quality rustproofing job range from \$100–\$250, depending on the area, the brand name and the size of the vehicle.

Ideally, the vehicle should be rustproofed as soon as possible following the purchase. The surfaces of the car or truck have begun to oxidize and deteriorate during shipping. In addition, the car may have sat on a dealer's lot or on a lot at the factory, and once the rust has progressed past the stage of light, powdery surface oxidation rustproofing is not likely to be worthwhile. Professional rustproofers feel that once rust has formed, rustproofing will simply seal in moisture already present. Most franchised rustproofing operations offer a 3–5 year warranty against rust-through, but will not support that warranty if the rustproofing is not applied within three months of the date of manufacture.

Undercoating should not be mistaken for rustproofing. Undercoating is a black, tar-like substance that is applied to the underside of a vehicle. Its basic function is to deaden noises that are transmitted from under the car. It simply cannot get into the crevices and seams where moisture tends to collect. In fact, it may clog up drainage holes and ventilation passages. Some undercoatings also tend to crack or peel with age and only create more moisture and corrosion attracting pockets.

The second thing you should do immediately after purchasing the car is apply a paint sealant. A sealant is a petroleum based product marketed under a wide variety of brand names. It has the same protective properties as a good wax, but bonds to the paint with a chemically inert layer that seals it from the air. If air can't get at the surface, oxidation cannot start.

The paint sealant kit consists of a base coat and a conditioning coat that should be applied every 6–8 months, depending on the manufacturer. The base coat must be applied before waxing, or the wax must first be removed.

Third, keep a garden hose handy for your car in winter. Use it a few times on nice days during the winter for underneath areas, and it will pay big dividends when spring arrives. Spraying under the fenders and other areas which even car washes don't reach will help remove road salt, dirt and other build-ups which help breed rust. Adjust the nozzle to a high-force spray. An old brush will help break up residue, permitting it to be washed away more easily.

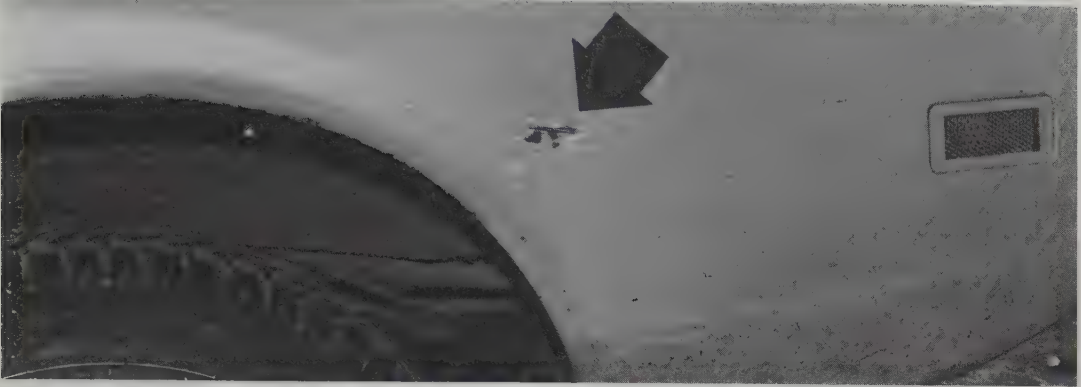
It's a somewhat messy job, but worth it in the long run because rust often starts in those hidden areas.

At the same time, wash grime off the door sills and, more importantly, the under portions of the doors, plus the tailgate if you have a station wagon or truck. Applying a coat of wax to those areas at least once before and once during winter will help fend off rust.

When applying the wax to the under parts of the doors, you will note small drain holes. These holes often are plugged with undercoating or dirt. Make sure they are cleaned out to prevent water build-up inside the doors. A small punch or penknife will do the job.

Water from the high-pressure sprays in car washes sometimes can get into the housings for parking and taillights, so take a close look. If they contain water merely loosen the retaining screws and the water should run out.

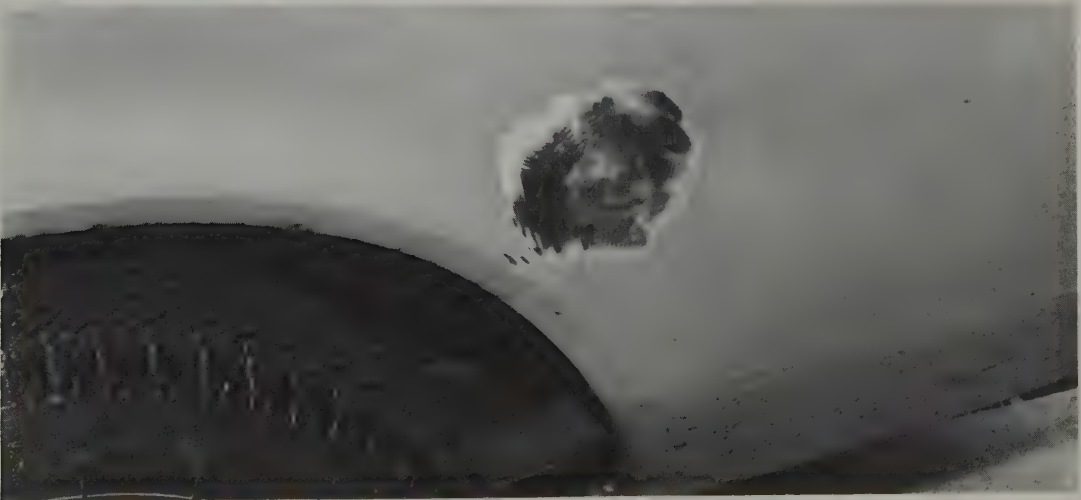
Repairing Scratches and Small Dents



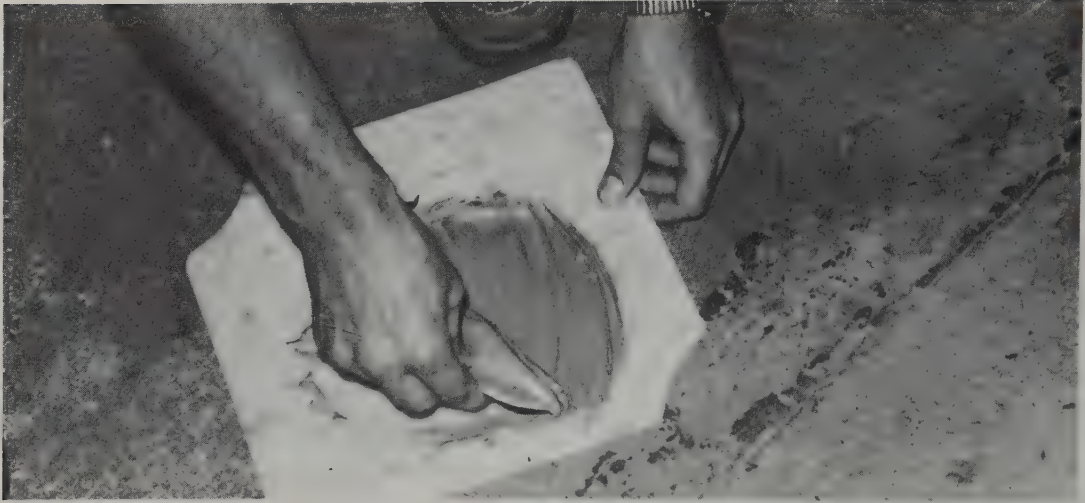
Step 1. This dent (arrow) is typical of a deep scratch or minor dent. If deep enough, the dent or scratch can be pulled out or hammered out from behind. In this case no straightening is necessary



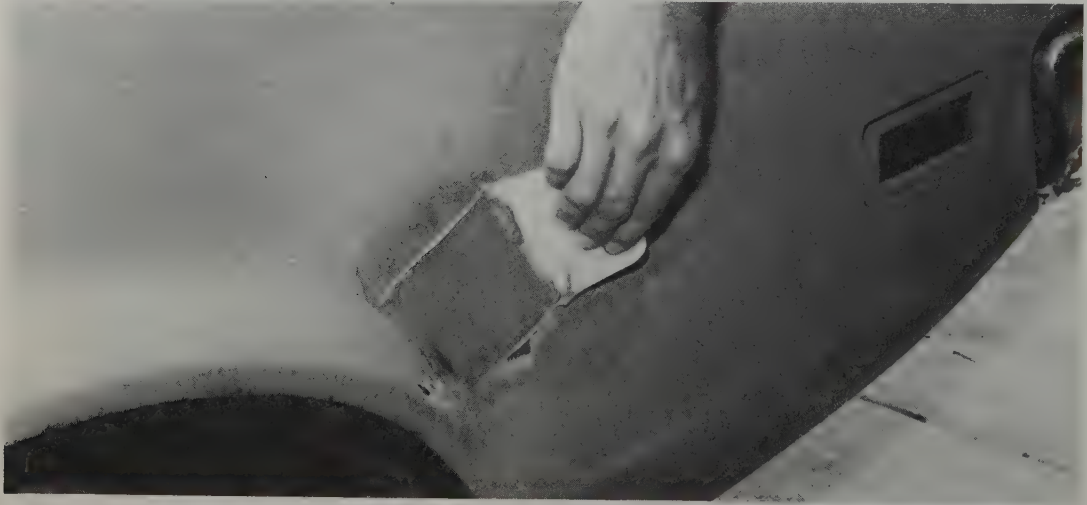
Step 2. Using an 80-grit grinding disc on an electric drill grind the paint from the surrounding area down to bare metal. This will provide a rough surface for the body filler to grab



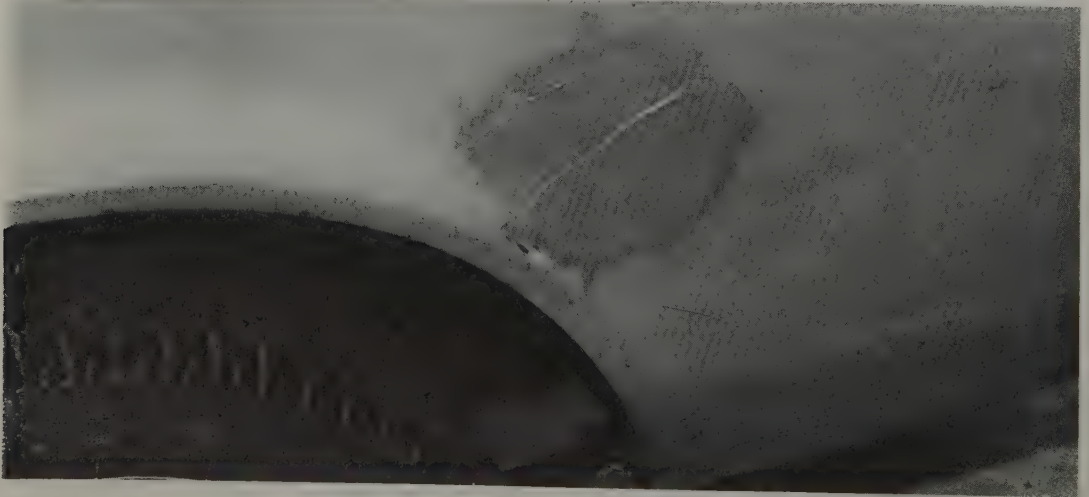
Step 3. The area should look like this when you're finished grinding



Step 4. Mix the body filler and cream hardener according to the directions



Step 5. Spread the body filler evenly over the entire area. Be sure to cover the area completely



Step 6. Let the body filler dry until the surface can just be scratched with your fingernail



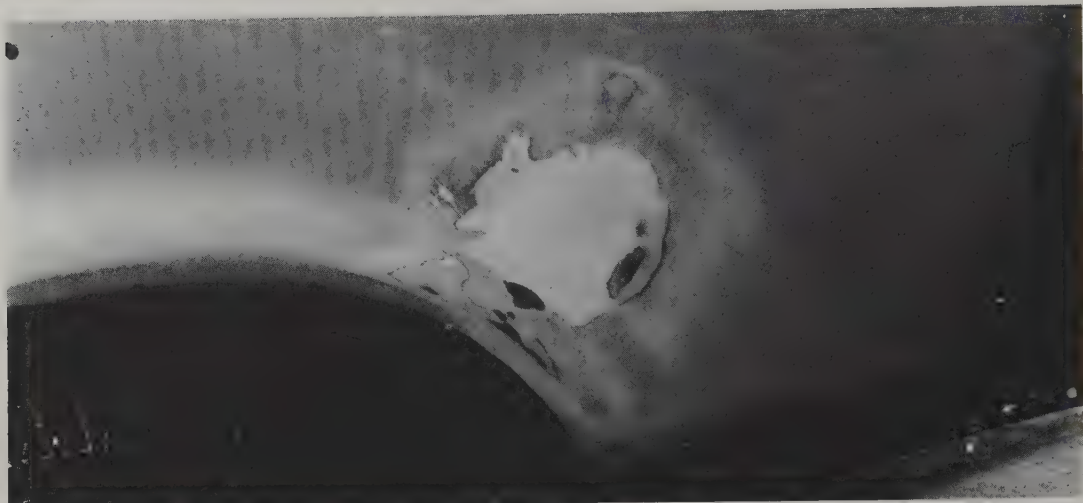
Step 7. Knock the high spots from the body filler with a body file



Step 8. Check frequently with the palm of your hand for high and low spots. If you wind up with low spots, you may have to apply another layer of filler



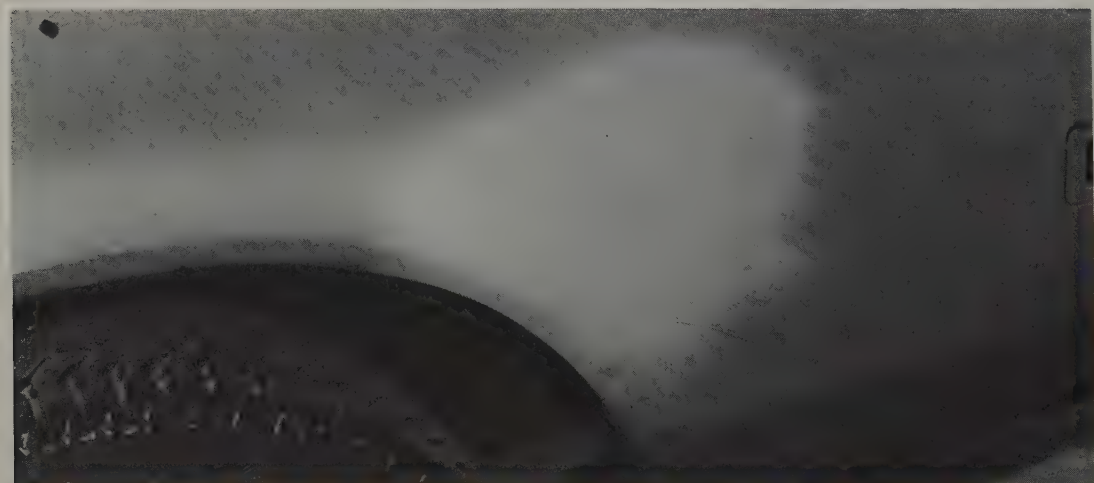
Step 9. Block sand the entire area with 320 grit paper



Step 10. When you're finished, the repair should look like this. Note the sand marks extending 2—3 inches out from the repaired area



Step 11. Prime the entire area with automotive primer



Step 12. The finished repair ready for the final paint coat. Note that the primer has covered the sanding marks (see Step 10). A repair of this size should be able to be spotpainted with good results

REPAIRING RUST HOLES

One thing you have to remember about rust: even if you grind away all the rusted metal in a panel, and repair the area with any of the kits available, *eventually* the rust will return. There are two reasons for this. One, rust is a chemical reaction that causes pressure under the repair from the inside out. That's how the blisters form. Two, the back side of the panel (and the repair) is wide open to moisture, and unpainted body filler acts like a sponge. That's why the best solution to rust problems

is to remove the rusted panel and install a new one or have the rusted area cut out and a new piece of sheet metal welded in its place. The trouble with welding is the expense; sometimes it will cost more than the car or truck is worth.

One of the better solutions to do-it-yourself rust repair is the process using a fiberglass cloth repair kit (shown here). This will give a strong repair that resists cracking and moisture and is relatively easy to use. It can be used on large or small holes and also can be applied over contoured surfaces.



Step 1. Rust areas such as this are common and are easily fixed



Step 2. Grind away all traces of rust with a 24-grit grinding disc. Be sure to grind back 3—4 inches from the edge of the hole down to bare metal and be sure all traces of rust are removed



Step 3. Be sure all rust is removed from the edges of the metal. The edges must be ground back to un-rusted metal



Step 4. If you are going to use release film, cut a piece about 2" larger than the area you have sanded. Place the film over the repair and mark the sanded area on the film. Avoid any unnecessary wrinkling of the film



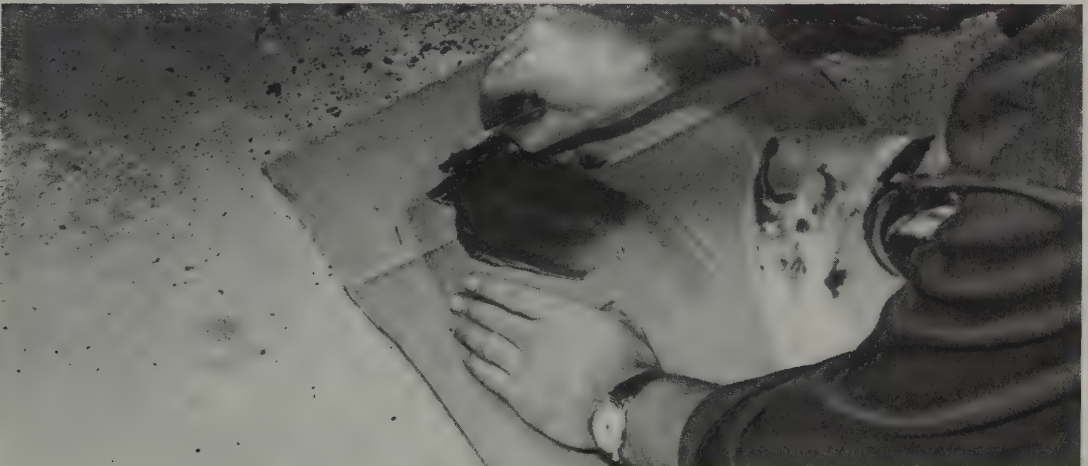
Step 5. Cut 2 pieces of fiberglass matting. One piece should be about 1" smaller than the sanded area and the second piece should be 1" smaller than the first. Use sharp scissors to avoid loose ends



Step 6. Check the dimensions of the release film and cloth by holding them up to the repair area



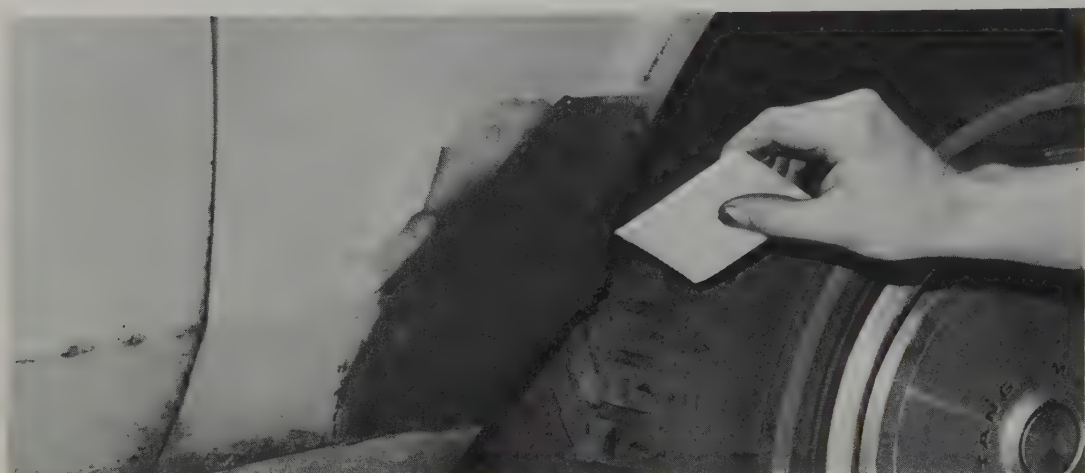
Step 7. Mix enough repair jelly and cream hardener in the mixing tray to saturate the fiberglass material or fill the repair area. Follow the directions on the container



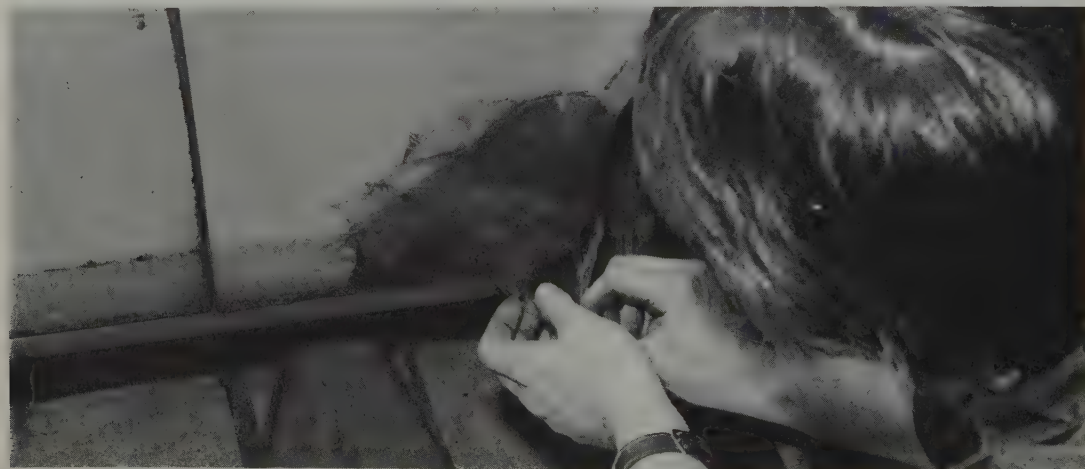
Step 8. Lay the release sheet on a flat surface and spread an even layer of filler, large enough to cover the repair. Lay the smaller piece of fiberglass cloth in the center of the sheet and spread another layer of repair jelly over the fiberglass cloth. Repeat the operation for the larger piece of cloth. If the fiberglass cloth is not used, spread the repair jelly on the release film, concentrated in the middle of the repair



Step 9. Place the repair material over the repair area, with the release film facing outward



Step 10. Use a spreader and work from the center outward to smooth the material, following the body contours. Be sure to remove all air bubbles



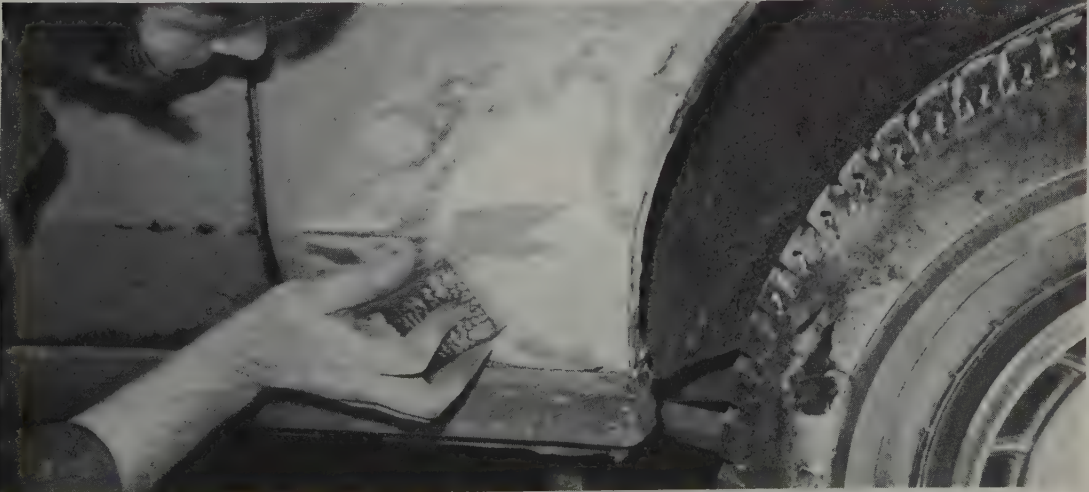
Step 11. Wait until the repair has dried tack-free and peel off the release sheet. The ideal working temperature is 65—90° F. Cooler or warmer temperatures or high humidity may require additional curing time



Step 12. Sand and feather-edge the entire area. The initial sanding can be done with a sanding disc on an electric drill if care is used. Finish the sanding with a block sander



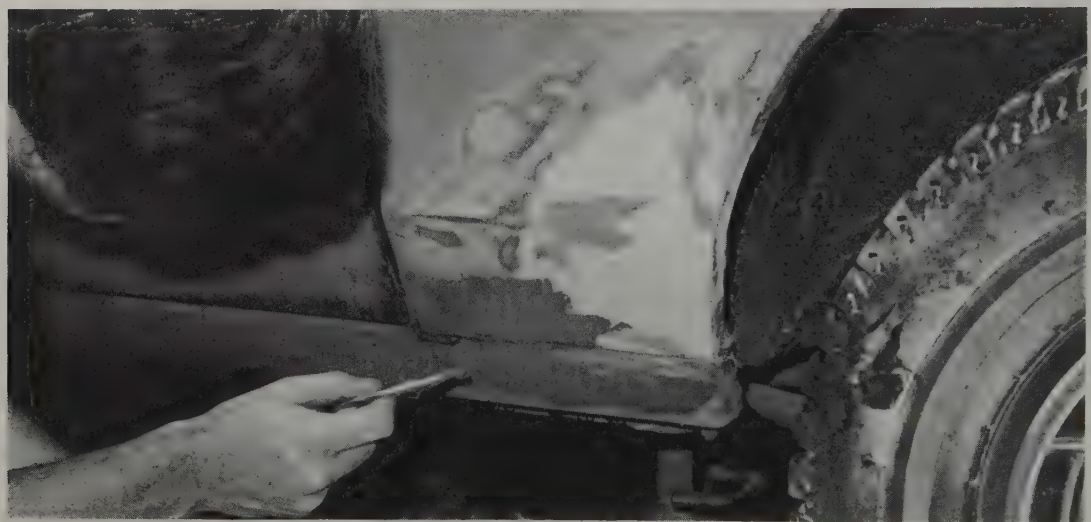
Step 13. When the area is sanded smooth, mix some topcoat and hardener and apply it directly with a spreader. This will give a smooth finish and prevent the glass matte from showing through the paint



Step 14. Block sand the topcoat with finishing sandpaper



Step 15. To finish this repair, grind out the surface rust along the top edge of the rocker panel



Step 16. Mix some more repair jelly and cream hardener and apply it directly over the surface



Step 17. When it dries tack-free, block sand the surface smooth



Step 18. If necessary, mask off adjacent panels and spray the entire repair with primer. You are now ready for a color coat

AUTO BODY CARE

There are hundreds—maybe thousands—of products on the market, all designed to protect or aid your car's finish in some manner. There are as many different products as there are ways to use them, but they all have one thing in common—the surface must be clean.

Washing

The primary ingredient for washing your car is water, preferably “soft” water. In many areas of the country, the local water supply is “hard” containing many minerals. The little rings or film that is left on your car's surface after it has dried is the result of “hard” water.

Since you usually can't change the local water supply, the next best thing is to dry the surface before it has a chance to dry itself.

Into the water you usually add soap. Don't use detergents or common, coarse soaps. Your car's paint never truly dries out, but is always evaporating residual oils into the air. Harsh detergents will remove these oils, causing the paint to dry faster than normal. Instead use warm water and a non-detergent soap made especially for waxed surfaces or a liquid soap made for waxed surfaces or a liquid soap made for washing dishes by hand.

Other products that can be used on painted surfaces include baking soda or plain soda water for stubborn dirt.

Wash the car completely, starting at the top, and rinse it completely clean. Abrasive grit should be loaded off under water pressure; scrubbing grit off will scratch the finish. The best washing tool is a sponge, cleaning mitt or soft towel. Whichever you choose, replace it often as each tends to absorb grease and dirt.

Other ways to get a better wash include:

- Don't wash your car in the sun or when the finish is hot.
- Use water pressure to remove caked-on dirt.
- Remove tree-sap and bird effluence immediately. Such substances will eat through wax, polish and paint.

One of the best implements to dry your car is a turkish towel or an old, soft bath towel. Anything with a deep nap will hold any dirt in suspension and not grind it into the paint.

Harder cloths will only grind the grit into the paint making more scratches. Always start drying at the top, followed by the hood and trunk and sides. You'll find there's always more dirt near the rocker panels and wheelwells which will wind up on the rest of the car if you dry these areas first.

Cleaners, Waxes and Polishes

Before going any farther you should know the function of various products.

Cleaners—remove the top layer of dead pigment or paint.

Rubbing or polishing compounds—used to remove stubborn dirt, get rid of minor scratches, smooth away imperfections and partially restore badly weathered paint.

Polishes—contain no abrasives or waxes; they shine the paint by adding oils to the paint.

Waxes—are a protective coating for the polish.

CLEANERS AND COMPOUNDS

Before you apply any wax, you'll have to remove oxidation, road film and other types of pollutants that washing alone will not remove.

The paint on your car never dries completely. There are always residual oils evaporating from the paint into the air. When enough oils are present in the paint, it has a healthy shine (gloss). When too many oils evaporate the paint takes on a whitish cast known as oxidation. The idea of polishing and waxing is to keep enough oil present in the painted surface to prevent oxidation; but when it occurs, the only recourse is to remove the top layer of "dead" paint, exposing the healthy paint underneath.

Products to remove oxidation and road film are sold under a variety of generic names—polishes, cleaner, rubbing compound, cleaner/polish, polish/cleaner, self-polishing wax, pre-wax cleaner, finish restorer and many more. Regardless of name there are two types of cleaners—abrasive cleaners (sometimes called polishing or rubbing compounds) that remove oxidation by grinding away the top layer of "dead" paint, or chemical cleaners that dissolve the "dead" pigment, allowing it to be wiped away.

Abrasive cleaners, by their nature, leave thousands of minute scratches in the finish, which must be polished out later. These should only be used in extreme cases, but are usually the only thing to use on badly oxidized paint finishes. Chemical cleaners are much milder but are not strong enough for severe cases of oxidation or weathered paint.

The most popular cleaners are liquid or paste abrasive polishing and rubbing compounds. Polishing compounds have a finer abrasive grit for medium duty work. Rubbing

compounds are a coarser abrasive and for heavy duty work. Unless you are familiar with how to use compounds, be very careful. Excessive rubbing with any type of compound or cleaner can grind right through the paint to primer or bare metal. Follow the directions on the container—depending on type, the cleaner may or may not be OK for your paint. For example, some cleaners are not formulated for acrylic lacquer finishes.

When a small area needs compounding or heavy polishing, it's best to do the job by hand. Some people prefer a powered buffer for large areas. Avoid cutting through the paint along styling edges on the body. Small, hand operations where the compound is applied and rubbed using cloth folded into a thick ball allow you to work in straight lines along such edges.

To avoid cutting through on the edges when using a power buffer, try masking tape. Just cover the edge with tape while using power. Then finish the job by hand with the tape removed. Even then work carefully. The paint tends to be a lot thinner along the sharp ridges stamped into the panels.

Whether compounding by machine or by hand, only work on a small area and apply the compound sparingly. If the materials are spread too thin, or allowed to sit too long, they dry out. Once dry they lose the ability to deliver a smooth, clean finish. Also, dried out polish tends to cause the buffer to stick in one spot. This in turn can burn or cut through the finish.

WAXES AND POLISHES

Your car's finish can be protected in a number of ways. A cleaner/wax or polish/cleaner followed by wax or variations of each all provide good results. The two-step approach (polish followed by wax) is probably slightly better but consumes more time and effort. Properly fed with oils, your paint should never need cleaning, but despite the best polishing job, it won't last unless it's protected with wax. Without wax, polish must be renewed at least once a month to prevent oxidation. Years ago (some still swear by it today), the best wax was made from the Brazilian palm, the Carnuba, favored for its vegetable base and high melting point. However, modern synthetic waxes are harder, which means they protect against moisture better, and chemically inert silicone is used for a long lasting protection. The only problem with silicone wax is that it penetrates all

layers of paint. To repaint or touch up a panel or car protected by silicone wax, you have to completely strip the finish to avoid "fish-eyes."

Under normal conditions, silicone waxes will last 4–6 months, but you have to be careful of wax build-up from too much waxing. Too thick a coat of wax is just as bad as no wax at all; it stops the paint from breathing.

Combination cleaners/waxes have become popular lately because they remove the old layer of wax plus light oxidation, while putting on a fresh coat of wax at the same time. Some cleaners/waxes contain abrasive cleaners which require caution, although many cleaner/waxes use a chemical cleaner.

Applying Wax or Polish

You may view polishing and waxing your car as a pleasant way to spend an afternoon, or as a boring chore, but it has to be done to keep the paint on your car. Caring for the paint doesn't require special tools, but you should follow a few rules.

1. Use a good quality wax.
2. Before applying any wax or polish, be sure the surface is completely clean. Just because the car looks clean, doesn't mean it's ready for polish or wax.
3. If the finish on your car is weathered, dull, or oxidized, it will probably have to be compounded to remove the old or oxidized paint. If the paint is simply dulled from lack of care, one of the non-abrasive cleaners known as polishing compounds will do the trick. If the paint is severely scratched or really dull, you'll probably have to use a rubbing compound to prepare the finish for waxing. If you're not sure which one to use, use the polishing compound, since you can easily ruin the finish by using too strong a compound.
4. Don't apply wax, polish or compound in direct sunlight, even if the directions on the can say you can. Most waxes will not cure properly in bright sunlight and you'll probably end up with a blotchy looking finish.
5. Don't rub the wax off too soon. The result will be a wet, dull looking finish. Let the wax dry thoroughly before buffing it off.
6. A constant debate among car enthusiasts is how wax should be applied. Some maintain pastes or liquids should be applied in a circular motion, but body shop experts have long thought that this approach results in barely detectable circular abrasions, especially on cars that are waxed frequently. They

advise rubbing in straight lines, especially if any kind of cleaner is involved.

7. If an applicator is not supplied with the wax, use a piece of soft cheesecloth or very soft lint-free material. The same applies to buffing the surface.

SPECIAL SURFACES

One-step combination cleaner and wax formulas shouldn't be used on many of the special surfaces which abound on cars. The one-step materials contain abrasives to achieve a clean surface under the wax top coat. The abrasives are so mild that you could clean a car every week for a couple of years without fear of rubbing through the paint. But this same level of abrasiveness might, through repeated use, damage decals used for special trim effects. This includes wide stripes, wood-grain trim and other appliques.

Painted plastics must be cleaned with care. If a cleaner is too aggressive it will cut through the paint and expose the primer. If bright trim such as polished aluminum or chrome is painted, cleaning must be performed with even greater care. If rubbing compound is being used, it will cut faster than polish.

Abrasive cleaners will dull an acrylic finish. The best way to clean these newer finishes is with a non-abrasive liquid polish. Only dirt and oxidation, not paint, will be removed.

Taking a few minutes to read the instructions on the can of polish or wax will help prevent making serious mistakes. Not all preparations will work on all surfaces. And some are intended for power application while others will only work when applied by hand.

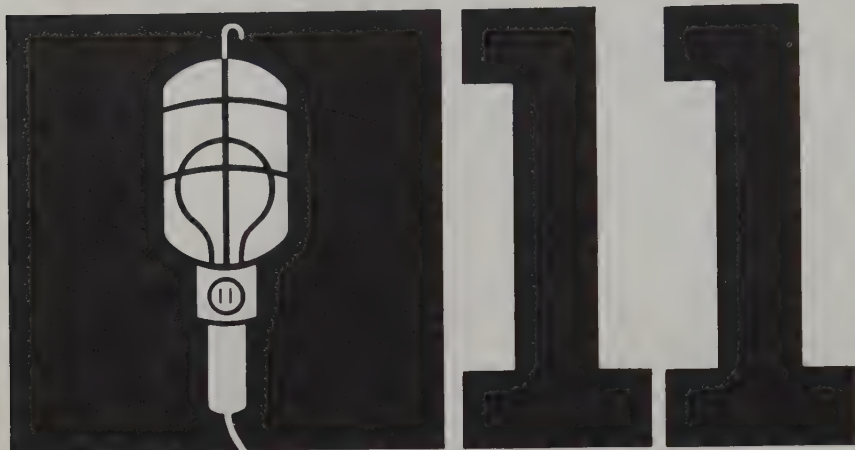
Don't get the idea that just pouring on some polish and then hitting it with a buffer will suffice. Power equipment speeds the operation. But it also adds a measure of risk. It's very easy to damage the finish if you use the wrong methods or materials.

Caring for Chrome

Read the label on the container. Many products are formulated specifically for chrome, but others contain abrasives that will scratch the chrome finish. If it isn't recommended for chrome, don't use it.

Never use steel wool or kitchen soap pads to clean chrome. Be careful not to get chrome cleaner on paint or interior vinyl surfaces. If you do, get it off immediately.

Troubleshooting



This section is designed to aid in the quick, accurate diagnosis of automotive problems. While automotive repairs can be made by many people, accurate troubleshooting is a rare skill for the amateur and professional alike.

In its simplest state, troubleshooting is an exercise in logic. It is essential to realize that an automobile is really composed of a series of systems. Some of these systems are interrelated; others are not. Automobiles operate within a framework of logical rules and physical laws, and the key to troubleshooting is a good understanding of all the automotive systems.

This section breaks the car or truck down into its component systems, allowing the problem to be isolated. The charts and diagnostic road maps list the most common problems and the most probable causes of trouble. Obviously it would be impossible to list every possible problem that could happen along with every possible cause, but it will locate MOST problems and eliminate a lot of unnecessary guesswork. The systematic format will locate problems within a given system, but, because many automotive systems are interrelated, the solution to your particular problem may be found in a number of systems on the car or truck.

USING THE TROUBLESHOOTING CHARTS

This book contains all of the specific information that the average do-it-yourself mechanic needs to repair and maintain his or her car or truck. The troubleshooting charts are designed to be used in conjunction with the specific procedures and information in the text. For instance, troubleshooting a point-type ignition system is fairly standard for all models, but you may be directed to the text to find procedures for troubleshooting an individual type of electronic ignition. You will also have to refer to the specification charts throughout the book for specifications applicable to your car or truck.

TOOLS AND EQUIPMENT

The tools illustrated in Chapter 1 (plus two more diagnostic pieces) will be adequate to troubleshoot most problems. The two other tools needed are a voltmeter and an ohmmeter. These can be purchased separately or in combination, known as a VOM meter.

In the event that other tools are required, they will be noted in the procedures.

Troubleshooting Engine Problems

See Chapters 2, 3, 4 for more information and service procedures.

Index to Systems

System	To Test	Group
Battery	Engine need not be running	1
Starting system	Engine need not be running	2
Primary electrical system	Engine need not be running	3
Secondary electrical system	Engine need not be running	4
Fuel system	Engine need not be running	5
Engine compression	Engine need not be running	6
Engine vacuum	Engine must be running	7
Secondary electrical system	Engine must be running	8
Valve train	Engine must be running	9
Exhaust system	Engine must be running	10
Cooling system	Engine must be running	11
Engine lubrication	Engine must be running	12

Index to Problems

Problem: Symptom	Begin at Specific Diagnosis, Number
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Engine Won't Start:

Starter doesn't turn	1.1, 2.1
Starter turns, engine doesn't	2.1
Starter turns engine very slowly	1.1, 2.4
Starter turns engine normally	3.1, 4.1
Starter turns engine very quickly	6.1
Engine fires intermittently	4.1
Engine fires consistently	5.1, 6.1

Engine Runs Poorly:

Hard starting	3.1, 4.1, 5.1, 8.1
Rough idle	4.1, 5.1, 8.1
Stalling	3.1, 4.1, 5.1, 8.1
Engine dies at high speeds	4.1, 5.1
Hesitation (on acceleration from standing stop)	5.1, 8.1
Poor pickup	4.1, 5.1, 8.1
Lack of power	3.1, 4.1, 5.1, 8.1
Backfire through the carburetor	4.1, 8.1, 9.1
Backfire through the exhaust	4.1, 8.1, 9.1
Blue exhaust gases	6.1, 7.1
Black exhaust gases	5.1
Running on (after the ignition is shut off)	3.1, 8.1
Susceptible to moisture	4.1
Engine misfires under load	4.1, 7.1, 8.4, 9.1
Engine misfires at speed	4.1, 8.4
Engine misfires at idle	3.1, 4.1, 5.1, 7.1, 8.4

Sample Section

Test and Procedure	Results and Indications	Proceed to
4.1—Check for spark: Hold each spark plug wire approximately $\frac{1}{4}$ " from ground with gloves or a heavy, dry rag. Crank the engine and observe the spark.	→ If no spark is evident: _____	→ 4.2
	→ If spark is good in some cases: _____	→ 4.3
	→ If spark is good in all cases: _____	→ 4.6

Specific Diagnosis

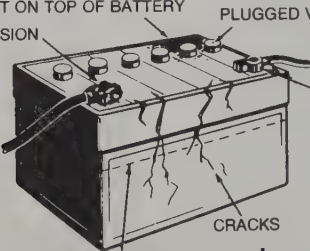
This section is arranged so that following each test, instructions are given to proceed to another, until a problem is diagnosed.

Section 1—Battery

Test and Procedure	Results and Indications	Proceed to
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1.1—Inspect the battery visually for case condition (corrosion, cracks) and water level.

DIRT ON TOP OF BATTERY
CORROSION
PLUGGED VENT
LOOSE CABLE OR POSTS
CRACKS
LOW WATER LEVEL



If case is cracked, replace battery:

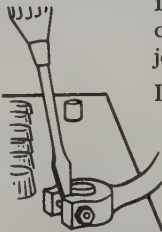
If the case is intact, remove corrosion with a solution of baking soda and water (**CAUTION: do not get the solution into the battery**), and fill with water:

1.4

1.2

Inspect the battery case

1.2—Check the battery cable connections: Insert a screwdriver between the battery post and the cable clamp. Turn the headlights on high beam, and observe them as the screwdriver is gently twisted to ensure good metal to metal contact.



If the lights brighten, remove and clean the clamp and post; coat the post with petroleum jelly, install and tighten the clamp:

If no improvement is noted:

1.4

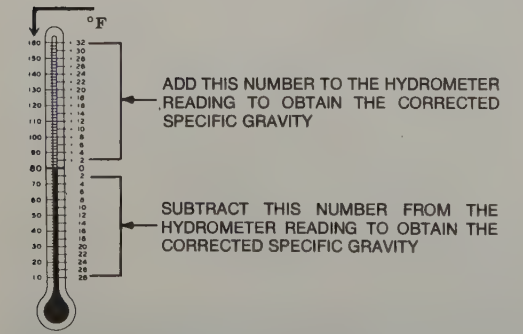
1.3

TESTING BATTERY CABLE CONNECTIONS USING A SCREWDRIVER

1.3—Test the state of charge of the battery using an individual cell tester or hydrometer.

If indicated, charge the battery. **NOTE: If no obvious reason exists for the low state of charge (i.e., battery age, prolonged storage), proceed to:**

1.4



Specific Gravity (@ 80° F.)

Minimum	Battery Charge
1.260	100% Charged
1.230	75% Charged
1.200	50% Charged
1.170	25% Charged
1.140	Very Little Power Left
1.110	Completely Discharged

The effects of temperature on battery specific gravity (left) and amount of battery charge in relation to specific gravity (right)

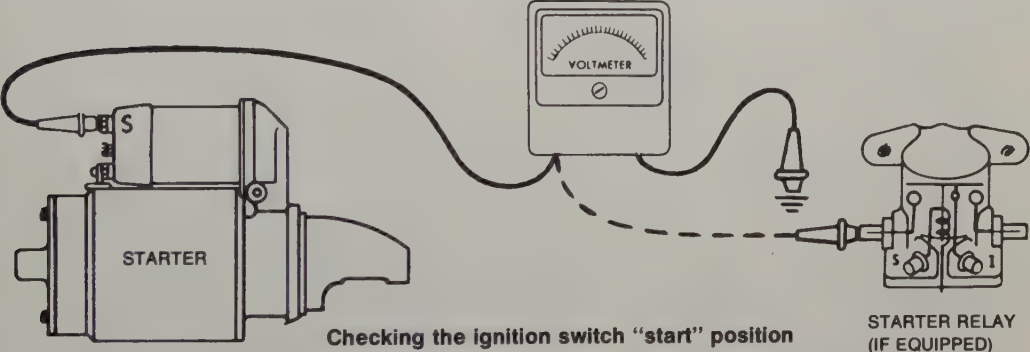
1.4—Visually inspect battery cables for cracking, bad connection to ground, or bad connection to starter.

If necessary, tighten connections or replace the cables:

2.1

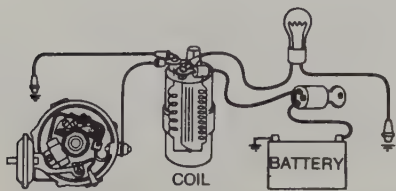
Section 2—Starting System

See Chapter 3 for service procedures

Test and Procedure	Results and Indications	Proceed to
Note: Tests in Group 2 are performed with coil high tension lead disconnected to prevent accidental starting.		
2.1 —Test the starter motor and solenoid: Connect a jumper from the battery post of the solenoid (or relay) to the starter post of the solenoid (or relay).	If starter turns the engine normally: 2.2 If the starter buzzes, or turns the engine very slowly: 2.4 If no response, replace the solenoid (or relay). 3.1 If the starter turns, but the engine doesn't, ensure that the flywheel ring gear is intact. If the gear is undamaged, replace the starter drive. 3.1	
2.2 —Determine whether ignition override switches are functioning properly (clutch start switch, neutral safety switch), by connecting a jumper across the switch(es), and turning the ignition switch to "start".	If starter operates, adjust or replace switch: 3.1 If the starter doesn't operate: 2.3	
2.3 —Check the ignition switch "start" position: Connect a 12V test lamp or voltmeter between the starter post of the solenoid (or relay) and ground. Turn the ignition switch to the "start" position, and jiggle the key.	If the lamp doesn't light or the meter needle doesn't move when the switch is turned, check the ignition switch for loose connections, cracked insulation, or broken wires. Repair or replace as necessary: 3.1 If the lamp flickers or needle moves when the key is jiggled, replace the ignition switch. 3.3	
 Checking the ignition switch "start" position		
2.4 —Remove and bench test the starter, according to specifications in the engine electrical section.	If the starter does not meet specifications, repair or replace as needed: 3.1 If the starter is operating properly: 2.5	
2.5 —Determine whether the engine can turn freely: Remove the spark plugs, and check for water in the cylinders. Check for water on the dipstick, or oil in the radiator. Attempt to turn the engine using an 18" flex drive and socket on the crankshaft pulley nut or bolt.	If the engine will turn freely only with the spark plugs out, and hydrostatic lock (water in the cylinders) is ruled out, check valve timing: 9.2 If engine will not turn freely, and it is known that the clutch and transmission are free, the engine must be disassembled for further evaluation: Chapter 3	

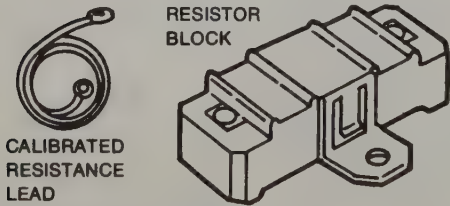
Section 3—Primary Electrical System

Test and Procedure	Results and Indications	Proceed to
3.1 —Check the ignition switch “on” position: Connect a jumper wire between the distributor side of the coil and ground, and a 12V test lamp between the switch side of the coil and ground. Remove the high tension lead from the coil. Turn the ignition switch on and jiggle the key.	If the lamp lights:	3.2
	If the lamp flickers when the key is jiggled, replace the ignition switch:	3.3
	If the lamp doesn’t light, check for loose or open connections. If none are found, remove the ignition switch and check for continuity.	3.3
	If the switch is faulty, replace it:	



Checking the ignition switch “on” position

3.2 —Check the ballast resistor or resistance wire for an open circuit, using an ohmmeter. See Chapter 3 for specific tests.	Replace the resistor or resistance wire if the resistance is zero. NOTE: <i>Some ignition systems have no ballast resistor.</i>	3.3
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Two types of resistors

3.3 —On point-type ignition systems, visually inspect the breaker points for burning, pitting or excessive wear. Gray coloring of the point contact surfaces is normal. Rotate the crankshaft until the contact heel rests on a high point of the distributor cam and adjust the point gap to specifications. On electronic ignition models, remove the distributor cap and visually inspect the armature. Ensure that the armature pin is in place, and that the armature is on tight and rotates when the engine is cranked. Make sure there are no cracks, chips or rounded edges on the armature.	If the breaker points are intact, clean the contact surfaces with fine emery cloth, and adjust the point gap to specifications. If the points are worn, replace them. On electronic systems, replace any parts which appear defective. If condition persists:	3.4
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Test and Procedure

Results and Indications

Proceed
to

3.4—On point-type ignition systems, connect a dwell-meter between the distributor primary lead and ground. Crank the engine and observe the point dwell angle. On electronic ignition systems, conduct a stator (magnetic pickup assembly) test. See Chapter 3.

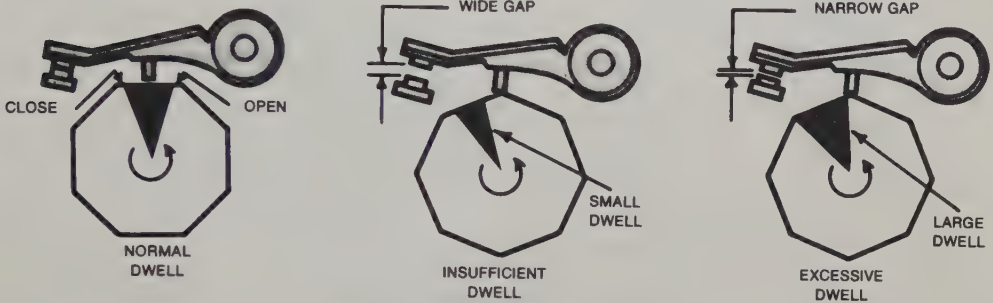
On point-type systems, adjust the dwell angle if necessary. **NOTE: Increasing the point gap decreases the dwell angle and vice-versa.**

3.6

If the dwell meter shows little or no reading;

3.5

On electronic ignition systems, if the stator is bad, replace the stator. If the stator is good, proceed to the other tests in Chapter 3.



Dwell is a function of point gap

3.5—On the point-type ignition systems, check the condenser for short: connect an ohmmeter across the condenser body and the pigtail lead.

If any reading other than infinite is noted, replace the condenser

3.6

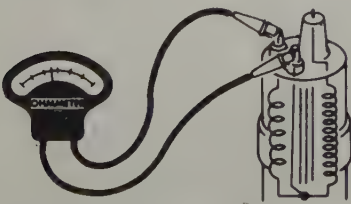


Checking the condenser for short

3.6—Test the coil primary resistance: On point-type ignition systems, connect an ohmmeter across the coil primary terminals, and read the resistance on the low scale. Note whether an external ballast resistor or resistance wire is used. On electronic ignition systems, test the coil primary resistance as in Chapter 3.

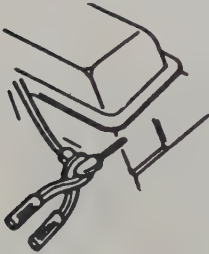
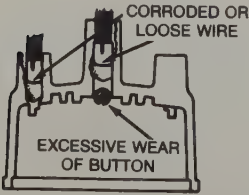
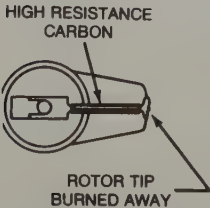
Point-type ignition coils utilizing ballast resistors or resistance wires should have approximately 1.0 ohms resistance. Coils with internal resistors should have approximately 4.0 ohms resistance. If values far from the above are noted, replace the coil.

4.1



Check the coil primary resistance

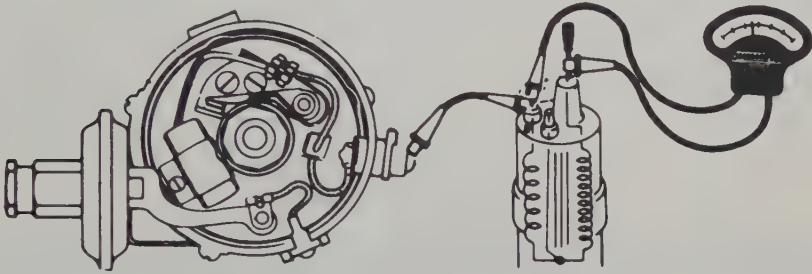
Section 4—Secondary Electrical System
See Chapters 2–3 for service procedures

Test and Procedure	Results and Indications	Proceed to
4.1—Check for spark: Hold each spark plug wire approximately ¼" from ground with gloves or a heavy, dry rag. Crank the engine, and observe the spark.	If no spark is evident: If spark is good in some cylinders: If spark is good in all cylinders:	4.2 4.3 4.6
		
Check for spark at the plugs		
4.2—Check for spark at the coil high tension lead: Remove the coil high tension lead from the distributor and position it approximately ¼" from ground. Crank the engine and observe spark. CAUTION: This test should not be performed on engines equipped with electronic ignition.	If the spark is good and consistent: If the spark is good but intermittent, test the primary electrical system starting at 3.3: If the spark is weak or non-existent, replace the coil high tension lead, clean and tighten all connections and retest. If no improvement is noted:	4.3 3.3 4.4
4.3—Visually inspect the distributor cap and rotor for burned or corroded contacts, cracks, carbon tracks, or moisture. Also check the fit of the rotor on the distributor shaft (where applicable).	If moisture is present, dry thoroughly, and retest per 4.1: If burned or excessively corroded contacts, cracks, or carbon tracks are noted, replace the defective part(s) and retest per 4.1: If the rotor and cap appear intact, or are only slightly corroded, clean the contacts thoroughly (including the cap towers and spark plug wire ends) and retest per 4.1: If the spark is good in all cases: If the spark is poor in all cases:	4.1 4.1 4.6 4.5
		
		
Inspect the distributor cap and rotor		

Test and Procedure**Results and Indications****Proceed to**

4.4—Check the coil secondary resistance: On point-type systems connect an ohmmeter across the distributor side of the coil and the coil tower. Read the resistance on the high scale of the ohmmeter. On electronic ignition systems, see Chapter 3 for specific tests.

The resistance of a satisfactory coil should be between 4,000 and 10,000 ohms. If resistance is considerably higher (i.e., 40,000 ohms) replace the coil and retest per 4.1. **NOTE: This does not apply to high performance coils.**



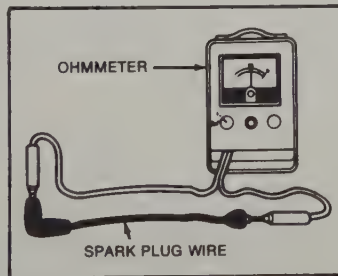
Testing the coil secondary resistance

4.5—Visually inspect the spark plug wires for cracking or brittleness. Ensure that no two wires are positioned so as to cause induction firing (adjacent and parallel). Remove each wire, one by one, and check resistance with an ohmmeter.

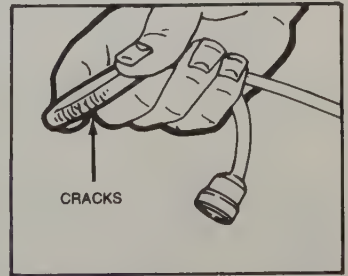
Replace any cracked or brittle wires. If any of the wires are defective, replace the entire set. Replace any wires with excessive resistance (over 8000 Ω per foot for suppression wire), and separate any wires that might cause induction firing.

4.6

Misfiring can be the result of spark plug leads to adjacent, consecutively firing cylinders running parallel and too close together



On point-type ignition systems, check the spark plug wires as shown. On electronic ignitions, do not remove the wire from the distributor cap terminal; instead, test through the cap



Spark plug wires can be checked visually by bending them in a loop over your finger. This will reveal any cracks, burned or broken insulation. Any wire with cracked insulation should be replaced

4.6—Remove the spark plugs, noting the cylinders from which they were removed, and evaluate according to the color photos in the middle of this book.

See following.

See following.

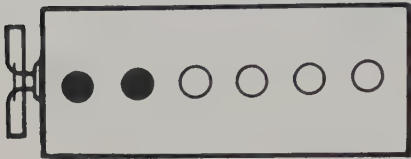
Test and Procedure

Results and Indications

4.7—Examine the location of all the plugs.

The following diagrams illustrate some of the conditions that the location of plugs will reveal.

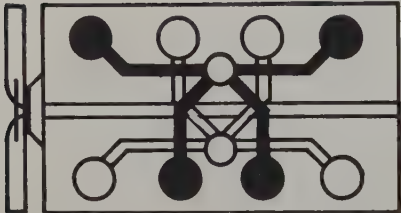
4.8



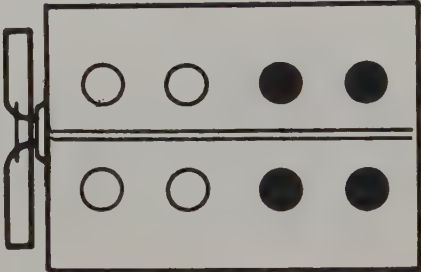
Two adjacent plugs are fouled in a 6-cylinder engine, 4-cylinder engine or either bank of a V-8. This is probably due to a blown head gasket between the two cylinders



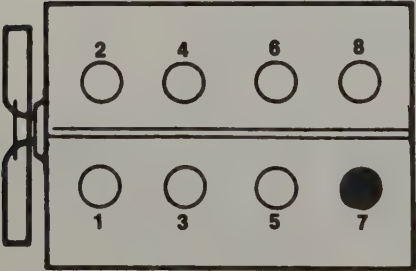
The two center plugs in a 6-cylinder engine are fouled. Raw fuel may be “boiled” out of the carburetor into the intake manifold after the engine is shut-off. Stop-start driving can also foul the center plugs, due to overly rich mixture. Proper float level, a new float needle and seat or use of an insulating spacer may help this problem



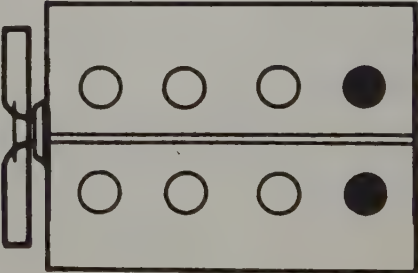
An unbalanced carburetor is indicated. Following the fuel flow on this particular design shows that the cylinders fed by the right-hand barrel are fouled from overly rich mixture, while the cylinders fed by the left-hand barrel are normal



If the four rear plugs are overheated, a cooling system problem is suggested. A thorough cleaning of the cooling system may restore coolant circulation and cure the problem



Finding one plug overheated may indicate an intake manifold leak near the affected cylinder. If the overheated plug is the second of two adjacent, consecutively firing plugs, it could be the result of ignition cross-firing. Separating the leads to these two plugs will eliminate cross-fire



Occasionally, the two rear plugs in large, lightly used V-8's will become oil fouled. High oil consumption and smoky exhaust may also be noticed. It is probably due to plugged oil drain holes in the rear of the cylinder head, causing oil to be sucked in around the valve stems. This usually occurs in the rear cylinders first, because the engine slants that way

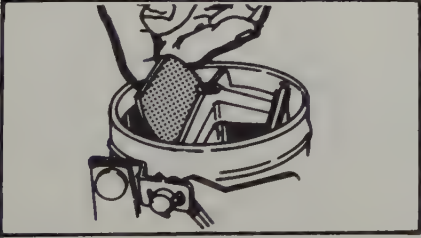
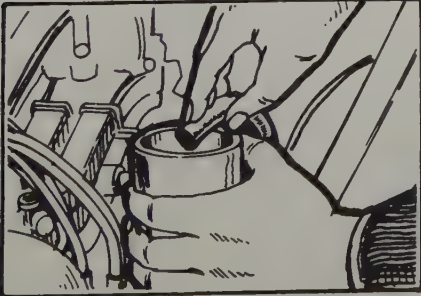
Test and Procedure	Results and Indications	Proceed to
4.8 —Determine the static ignition timing. Using the crankshaft pulley timing marks as a guide, locate top dead center on the compression stroke of the number one cylinder.	The rotor should be pointing toward the No. 1 tower in the distributor cap, and, on electronic ignitions, the armature spoke for that cylinder should be lined up with the stator.	4.8
4.9 —Check coil polarity: Connect a voltmeter negative lead to the coil high tension lead, and the positive lead to ground (NOTE: Reverse the hook-up for positive ground systems). Crank the engine momentarily.	If the voltmeter reads up-scale, the polarity is correct: If the voltmeter reads down-scale, reverse the coil polarity (switch the primary leads):	5.1 5.1



Checking coil polarity

Section 5—Fuel System

See Chapter 4 for service procedures

Test and Procedure	Results and Indications	Proceed to
5.1 —Determine that the air filter is functioning efficiently: Hold paper elements up to a strong light, and attempt to see light through the filter.	Clean permanent air filters in solvent (or manufacturer's recommendation), and allow to dry. Replace paper elements through which light cannot be seen:	5.2
5.2 —Determine whether a flooding condition exists: Flooding is identified by a strong gasoline odor, and excessive gasoline present in the throttle bore(s) of the carburetor.	If flooding is not evident: If flooding is evident, permit the gasoline to dry for a few moments and restart. If flooding doesn't recur: If flooding is persistent:	5.3 5.7 5.5
	If the engine floods repeatedly, check the choke butterfly flap	
5.3 —Check that fuel is reaching the carburetor: Detach the fuel line at the carburetor inlet. Hold the end of the line in a cup (not styrofoam), and crank the engine.	If fuel flows smoothly: If fuel doesn't flow (NOTE: Make sure that there is fuel in the tank), or flows erratically:	5.7 5.4
	Check the fuel pump by disconnecting the output line (fuel pump-to-carburetor) at the carburetor and operating the starter briefly	

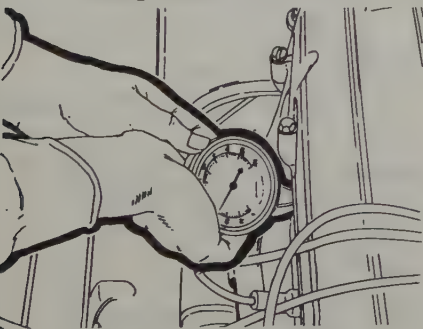
Test and Procedure	Results and Indications	Proceed to
5.4—Test the fuel pump: Disconnect all fuel lines from the fuel pump. Hold a finger over the input fitting, crank the engine (with electric pump, turn the ignition or pump on); and feel for suction.	If suction is evident, blow out the fuel line to the tank with low pressure compressed air until bubbling is heard from the fuel filler neck. Also blow out the carburetor fuel line (both ends disconnected): If no suction is evident, replace or repair the fuel pump: NOTE: <i>Repeated oil fouling of the spark plugs, or a no-start condition, could be the result of a ruptured vacuum booster pump diaphragm, through which oil or gasoline is being drawn into the intake manifold (where applicable).</i>	5.7 5.7
5.5—Occasionally, small specks of dirt will clog the small jets and orifices in the carburetor. With the engine cold, hold a flat piece of wood or similar material over the carburetor, where possible, and crank the engine.	If the engine starts, but runs roughly the engine is probably not run enough. If the engine won't start:	5.9
5.6—Check the needle and seat: Tap the carburetor in the area of the needle and seat.	If flooding stops, a gasoline additive (e.g., Gumout) will often cure the problem: If flooding continues, check the fuel pump for excessive pressure at the carburetor (according to specifications). If the pressure is normal, the needle and seat must be removed and checked, and/or the float level adjusted:	5.7 5.7
5.7—Test the accelerator pump by looking into the throttle bores while operating the throttle. Check for gas at the carburetor by looking down the carburetor throat while someone moves the accelerator	If the accelerator pump appears to be operating normally: If the accelerator pump is not operating, the pump must be reconditioned. Where possible, service the pump with the carburetor(s) installed on the engine. If necessary, remove the carburetor. Prior to removal:	5.8 5.8
5.8—Determine whether the carburetor main fuel system is functioning: Spray a commercial starting fluid into the carburetor while attempting to start the engine.	If the engine starts, runs for a few seconds, and dies: If the engine doesn't start:	5.9 6.1

Test and Procedure			Results and Indications	Proceed to
5.9—Uncommon fuel system malfunctions: See below:			If the problem is solved: If the problem remains, remove and recondition the carburetor.	6.1
Condition	Indication	Test	Prevailing Weather Conditions	Remedy
Vapor lock	Engine will not restart shortly after running.	Cool the components of the fuel system until the engine starts. Vapor lock can be cured faster by draping a wet cloth over a mechanical fuel pump.	Hot to very hot	Ensure that the exhaust manifold heat control valve is operating. Check with the vehicle manufacturer for the recommended solution to vapor lock on the model in question.
Carburetor icing	Engine will not idle, stalls at low speeds.	Visually inspect the throttle plate area of the throttle bores for frost.	High humidity, 32–40° F.	Ensure that the exhaust manifold heat control valve is operating, and that the intake manifold heat riser is not blocked.
Water in the fuel	Engine sputters and stalls; may not start.	Pump a small amount of fuel into a glass jar. Allow to stand, and inspect for droplets or a layer of water.	High humidity, extreme temperature changes.	For droplets, use one or two cans of commercial gas line anti-freeze. For a layer of water, the tank must be drained, and the fuel lines blown out with compressed air.

Section 6—Engine Compression

See Chapter 3 for service procedures

- 6.1—Test engine compression:** Remove all spark plugs. Block the throttle wide open. Insert a compression gauge into a spark plug port, crank the engine to obtain the maximum reading, and record.
- If compression is within limits on all cylinders: **7.1**
- If gauge reading is extremely low on all cylinders: **6.2**
- If gauge reading is low on one or two cylinders: **6.2**
- (If gauge readings are identical and low on two or more adjacent cylinders, the head gasket must be replaced.)



Checking compression

- 6.2—Test engine compression (wet):** Squirt approximately 30 cc. of engine oil into each cylinder, and retest per 6.1.
- If the readings improve, worn or cracked rings or broken pistons are indicated: **See Chapter 3**
- If the readings do not improve, burned or excessively carboned valves or a jumped timing chain are indicated: **7.1**
- NOTE:** A jumped timing chain is often indicated by difficult cranking.

Section 7—Engine Vacuum

See Chapter 3 for service procedures

Test and Procedure	Results and Indications	Proceed to
7.1—Attach a vacuum gauge to the intake manifold beyond the throttle plate. Start the engine, and observe the action of the needle over the range of engine speeds.	See below.	See below
 Normal engine Gauge reading: steady, from 17–22 in./Hg.	INDICATION: normal engine in good condition Proceed to: 8.1	INDICATION: sticking valves or ignition miss Proceed to: 9.1, 8.3
 Incorrect valve timing Gauge reading: low (10–15 in./Hg) but steady	INDICATION: late ignition or valve timing, low compression, stuck throttle valve, leaking carburetor or manifold gasket Proceed to: 6.1	INDICATION: improper carburetor adjustment or minor intake leak. Proceed to: 7.2
 Blown head gasket Gauge reading: needle fluctuates as engine speed increases	INDICATION: ignition miss, blown cylinder head gasket, leaking valve or weak valve spring Proceed to: 8.3, 6.1	INDICATION: burnt valve or faulty valve clearance: Needle will fall when defective valve operates Proceed to: 9.1
 Clogged exhaust system Gauge reading: gradual drop in reading at idle	INDICATION: choked muffler, excessive back pressure in system Proceed to: 10.1	INDICATION: worn valve guides Proceed to: 9.1
White pointer = steady gauge hand	Black pointer = fluctuating gauge hand	Worn valve guides Gauge reading: needle vibrates excessively at idle, but steadies as engine speed increases

Test and Procedure	Results and Indications	Proceed to
7.2 —Attach a vacuum gauge per 7.1, and test for an intake manifold leak. Squirt a small amount of oil around the intake manifold gaskets, carburetor gaskets, plugs and fittings. Observe the action of the vacuum gauge.	If the reading improves, replace the indicated gasket, or seal the indicated fitting or plug: If the reading remains low:	8.1 7.3
7.3 —Test all vacuum hoses and accessories for leaks as described in 7.2. Also check the carburetor body (dashpots, automatic choke mechanism, throttle shafts) for leaks in the same manner.	If the reading improves, service or replace the offending part(s): If the reading remains low:	8.1 6.1

Section 8—Secondary Electrical System

See Chapter 2 for service procedures

Test and Procedure	Results and Indications	Proceed to
8.1 —Remove the distributor cap and check to make sure that the rotor turns when the engine is cranked. Visually inspect the distributor components.	Clean, tighten or replace any components which appear defective.	8.2
8.2 —Connect a timing light (per manufacturer's recommendation) and check the dynamic ignition timing. Disconnect and plug the vacuum hose(s) to the distributor if specified, start the engine, and observe the timing marks at the specified engine speed.	If the timing is not correct, adjust to specifications by rotating the distributor in the engine: (Advance timing by rotating distributor opposite normal direction of rotor rotation, retard timing by rotating distributor in same direction as rotor rotation.)	8.3
8.3 —Check the operation of the distributor advance mechanism(s): To test the mechanical advance, disconnect the vacuum lines from the distributor advance unit and observe the timing marks with a timing light as the engine speed is increased from idle. If the mark moves smoothly, without hesitation, it may be assumed that the mechanical advance is functioning properly. To test vacuum advance and/or retard systems, alternately crimp and release the vacuum line, and observe the timing mark for movement. If movement is noted, the system is operating.	If the systems are functioning: If the systems are not functioning, remove the distributor, and test on a distributor tester:	8.4 8.4
8.4 —Locate an ignition miss: With the engine running, remove each spark plug wire, one at a time, until one is found that doesn't cause the engine to roughen and slow down.	When the missing cylinder is identified:	4.1

Section 9—Valve Train
See Chapter 3 for service procedures

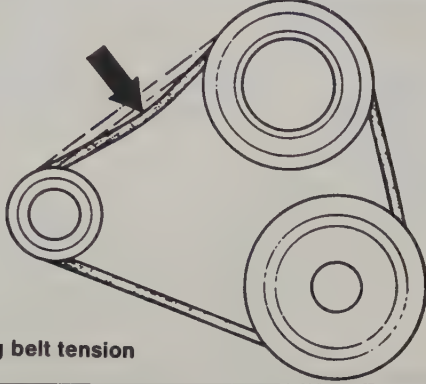
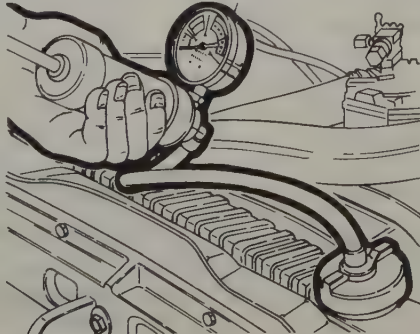
Test and Procedure	Results and Indications	Proceed to
9.1—Evaluate the valve train: Remove the valve cover, and ensure that the valves are adjusted to specifications. A mechanic's stethoscope may be used to aid in the diagnosis of the valve train. By pushing the probe on or near push rods or rockers, valve noise often can be isolated. A timing light also may be used to diagnose valve problems. Connect the light according to manufacturer's recommendations, and start the engine. Vary the firing moment of the light by increasing the engine speed (and therefore the ignition advance), and moving the trigger from cylinder to cylinder. Observe the movement of each valve.	Sticking valves or erratic valve train motion can be observed with the timing light. The cylinder head must be disassembled for repairs.	See Chapter 3
9.2—Check the valve timing: Locate top dead center of the No. 1 piston, and install a degree wheel or tape on the crankshaft pulley or damper with zero corresponding to an index mark on the engine. Rotate the crankshaft in its direction of rotation, and observe the opening of the No. 1 cylinder intake valve. The opening should correspond with the correct mark on the degree wheel according to specifications.	If the timing is not correct, the timing cover must be removed for further investigation.	See Chapter 3

Section 10—Exhaust System

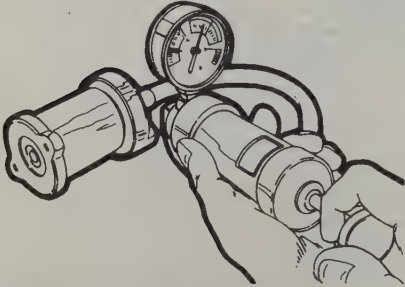
Test and Procedure	Results and Indications	Proceed to
10.1—Determine whether the exhaust manifold heat control valve is operating: Operate the valve by hand to determine whether it is free to move. If the valve is free, run the engine to operating temperature and observe the action of the valve, to ensure that it is opening.	If the valve sticks, spray it with a suitable solvent, open and close the valve to free it, and retest. If the valve functions properly:	10.2
	If the valve does not free, or does not operate, replace the valve:	10.2
10.2—Ensure that there are no exhaust restrictions: Visually inspect the exhaust system for kinks, dents, or crushing. Also note that gases are flowing freely from the tailpipe at all engine speeds, indicating no restriction in the muffler or resonator.	Replace any damaged portion of the system:	11.1

Section 11—Cooling System

See Chapter 3 for service procedures

Test and Procedure	Results and Indications	Proceed to
11.1 —Visually inspect the fan belt for glazing, cracks, and fraying, and replace if necessary. Tighten the belt so that the longest span has approximately $\frac{1}{2}$ " play at its midpoint under thumb pressure (see Chapter 1).	Replace or tighten the fan belt as necessary: 	11.2
11.2 —Check the fluid level of the cooling system.	If full or slightly low, fill as necessary:	11.5
	If extremely low:	11.3
11.3 —Visually inspect the external portions of the cooling system (radiator, radiator hoses, thermostat elbow, water pump seals, heater hoses, etc.) for leaks. If none are found, pressurize the cooling system to 14–15 psi.	If cooling system holds the pressure:	11.5
	If cooling system loses pressure rapidly, reinspect external parts of the system for leaks under pressure. If none are found, check dipstick for coolant in crankcase. If no coolant is present, but pressure loss continues:	11.4
	If coolant is evident in crankcase, remove cylinder head(s), and check gasket(s). If gaskets are intact, block and cylinder head(s) should be checked for cracks or holes.	
	If the gasket(s) is blown, replace, and purge the crankcase of coolant:	12.6
	NOTE: <i>Occasionally, due to atmospheric and driving conditions, condensation of water can occur in the crankcase. This causes the oil to appear milky white. To remedy, run the engine until hot, and change the oil and oil filter.</i>	
11.4 —Check for combustion leaks into the cooling system: Pressurize the cooling system as above. Start the engine, and observe the pressure gauge. If the needle fluctuates, remove each spark plug wire, one at a time, noting which cylinder(s) reduce or eliminate the fluctuation.	Cylinders which reduce or eliminate the fluctuation, when the spark plug wire is removed, are leaking into the cooling system. Replace the head gasket on the affected cylinder bank(s). 	

Pressurizing the cooling system

Test and Procedure	Results and Indications	Proceed to
11.5 —Check the radiator pressure cap: Attach a radiator pressure tester to the radiator cap (wet the seal prior to installation). Quickly pump up the pressure, noting the point at which the cap releases.	If the cap releases within ± 1 psi of the specified rating, it is operating properly:	11.6
	If the cap releases at more than ± 1 psi of the specified rating, it should be replaced:	11.6
		
Checking radiator pressure cap		
11.6 —Test the thermostat: Start the engine cold, remove the radiator cap, and insert a thermometer into the radiator. Allow the engine to idle. After a short while, there will be a sudden, rapid increase in coolant temperature. The temperature at which this sharp rise stops is the thermostat opening temperature.	If the thermostat opens at or about the specified temperature:	11.7
	If the temperature doesn't increase: (If the temperature increases slowly and gradually, replace the thermostat.)	11.7
11.7 —Check the water pump: Remove the thermostat elbow and the thermostat, disconnect the coil high tension lead (to prevent starting), and crank the engine momentarily.	If coolant flows, replace the thermostat and retest per 11.6:	11.6
	If coolant doesn't flow, reverse flush the cooling system to alleviate any blockage that might exist. If system is not blocked, and coolant will not flow, replace the water pump.	

Section 12—Lubrication
See Chapter 3 for service procedures

Test and Procedure	Results and Indications	Proceed to
12.1 —Check the oil pressure gauge or warning light: If the gauge shows low pressure, or the light is on for no obvious reason, remove the oil pressure sender. Install an accurate oil pressure gauge and run the engine momentarily.	If oil pressure builds normally, run engine for a few moments to determine that it is functioning normally, and replace the sender.	—
	If the pressure remains low:	12.2
	If the pressure surges:	12.3
	If the oil pressure is zero:	12.3
12.2 —Visually inspect the oil: If the oil is watery or very thin, milky, or foamy, replace the oil and oil filter.	If the oil is normal:	12.3
	If after replacing oil the pressure remains low:	12.3
	If after replacing oil the pressure becomes normal:	—

Test and Procedure	Results and Indications	Proceed to
12.3 —Inspect the oil pressure relief valve and spring, to ensure that it is not sticking or stuck. Remove and thoroughly clean the valve, spring, and the valve body.	If the oil pressure improves: If no improvement is noted:	— 12.4
12.4 —Check to ensure that the oil pump is not cavitating (sucking air instead of oil): See that the crankcase is neither over nor underfull, and that the pickup in the sump is in the proper position and free from sludge.	Fill or drain the crankcase to the proper capacity, and clean the pickup screen in solvent if necessary. If no improvement is noted:	12.5
12.5 —Inspect the oil pump drive and the oil pump:	If the pump drive or the oil pump appear to be defective, service as necessary and retest per 12.1: If the pump drive and pump appear to be operating normally, the engine should be disassembled to determine where blockage exists:	12.1 See Chapter 3
12.6 —Purge the engine of ethylene glycol coolant: Completely drain the crankcase and the oil filter. Obtain a commercial butyl cellosolve base solvent, designated for this purpose, and follow the instructions precisely. Following this, install a new oil filter and refill the crankcase with the proper weight oil. The next oil and filter change should follow shortly thereafter (1000 miles).		

TROUBLESHOOTING EMISSION CONTROL SYSTEMS

See Chapter 4 for procedures applicable to individual emission control systems used on specific combinations of engine/transmission/model.

TROUBLESHOOTING THE CARBURETOR

See Chapter 4 for service procedures

Carburetor problems cannot be effectively isolated unless all other engine systems (particularly ignition and emission) are functioning properly and the engine is properly tuned.

Condition**Possible Cause**

Engine cranks, but does not start

1. Improper starting procedure
2. No fuel in tank
3. Clogged fuel line or filter
4. Defective fuel pump
5. Choke valve not closing properly
6. Engine flooded
7. Choke valve not unloading
8. Throttle linkage not making full travel
9. Stuck needle or float
10. Leaking float needle or seat
11. Improper float adjustment

Engine stalls

1. Improperly adjusted idle speed or mixture
Engine hot
2. Improperly adjusted dashpot
3. Defective or improperly adjusted solenoid
4. Incorrect fuel level in fuel bowl
5. Fuel pump pressure too high
6. Leaking float needle seat
7. Secondary throttle valve stuck open
8. Air or fuel leaks
9. Idle air bleeds plugged or missing
10. Idle passages plugged
Engine Cold
11. Incorrectly adjusted choke
12. Improperly adjusted fast idle speed
13. Air leaks
14. Plugged idle or idle air passages
15. Stuck choke valve or binding linkage
16. Stuck secondary throttle valves
17. Engine flooding—high fuel level
18. Leaking or misaligned float

Engine hesitates on acceleration

1. Clogged fuel filter
2. Leaking fuel pump diaphragm
3. Low fuel pump pressure
4. Secondary throttle valves stuck, bent or misadjusted
5. Sticking or binding air valve
6. Defective accelerator pump
7. Vacuum leaks
8. Clogged air filter
9. Incorrect choke adjustment (engine cold)

Engine feels sluggish or flat on acceleration

1. Improperly adjusted idle speed or mixture
2. Clogged fuel filter
3. Defective accelerator pump
4. Dirty, plugged or incorrect main metering jets
5. Bent or sticking main metering rods
6. Sticking throttle valves
7. Stuck heat riser
8. Binding or stuck air valve
9. Dirty, plugged or incorrect secondary jets
10. Bent or sticking secondary metering rods.
11. Throttle body or manifold heat passages plugged
12. Improperly adjusted choke or choke vacuum break.

Carburetor floods

1. Defective fuel pump. Pressure too high.
2. Stuck choke valve
3. Dirty, worn or damaged float or needle valve/seat
4. Incorrect float/fuel level
5. Leaking float bowl

Condition	Possible Cause
Engine idles roughly and stalls	1. Incorrect idle speed 2. Clogged fuel filter 3. Dirt in fuel system or carburetor 4. Loose carburetor screws or attaching bolts 5. Broken carburetor gaskets 6. Air leaks 7. Dirty carburetor 8. Worn idle mixture needles 9. Throttle valves stuck open 10. Incorrectly adjusted float or fuel level 11. Clogged air filter
Engine runs unevenly or surges	1. Defective fuel pump 2. Dirty or clogged fuel filter 3. Plugged, loose or incorrect main metering jets or rods 4. Air leaks 5. Bent or sticking main metering rods 6. Stuck power piston 7. Incorrect float adjustment 8. Incorrect idle speed or mixture 9. Dirty or plugged idle system passages 10. Hard, brittle or broken gaskets 11. Loose attaching or mounting screws 12. Stuck or misaligned secondary throttle valves
Poor fuel economy	1. Poor driving habits 2. Stuck choke valve 3. Binding choke linkage 4. Stuck heat riser 5. Incorrect idle mixture 6. Defective accelerator pump 7. Air leaks 8. Plugged, loose or incorrect main metering jets 9. Improperly adjusted float or fuel level 10. Bent, misaligned or fuel-clogged float 11. Leaking float needle seat 12. Fuel leak 13. Accelerator pump discharge ball not seating properly 14. Incorrect main jets
Engine lacks high speed performance or power	1. Incorrect throttle linkage adjustment 2. Stuck or binding power piston 3. Defective accelerator pump 4. Air leaks 5. Incorrect float setting or fuel level 6. Dirty, plugged, worn or incorrect main metering jets or rods 7. Binding or sticking air valve 8. Brittle or cracked gaskets 9. Bent, incorrect or improperly adjusted secondary metering rods 10. Clogged fuel filter 11. Clogged air filter 12. Defective fuel pump

TROUBLESHOOTING FUEL INJECTION PROBLEMS

Each fuel injection system has its own unique components and test procedures, for which it is impossible to generalize. Refer to Chapter

4 of this Repair & Tune-Up Guide for specific test and repair procedures, if the vehicle is equipped with fuel injection.

TRUBLESHOOTING ELECTRICAL PROBLEMS

See Chapter 5 for service procedures

For any electrical system to operate, it must make a complete circuit. This simply means that the power flow from the battery must make a complete circle. When an electrical component is operating, power flows from the battery to the component, passes through the component causing it to perform its function (lighting a light bulb), and then returns to the battery through the ground of the circuit. This ground is usually (but not always) the metal part of the car or truck on which the electrical component is mounted.

Perhaps the easiest way to visualize this is to think of connecting a light bulb with two wires attached to it to the battery. If one of the two wires attached to the light bulb were attached to the negative post of the battery and the other were attached to the positive post of the battery, you would have a complete circuit. Current from the battery would flow to the light bulb, causing it to light, and return to the negative post of the battery.

The normal automotive circuit differs from this simple example in two ways. First, instead of having a return wire from the bulb to the battery, the light bulb returns the current to the battery through the chassis of the vehicle. Since the negative battery cable is attached to the chassis and the chassis is made of electrically conductive metal, the chassis of the vehicle can serve as a ground wire to complete the circuit. Secondly, most automotive circuits contain switches to turn components on and off as required.

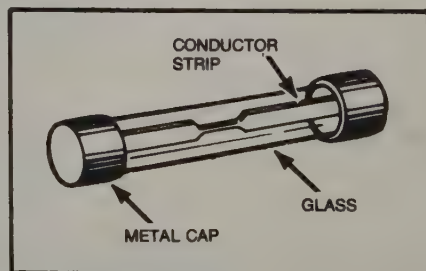
Every complete circuit from a power source must include a component which is using the power from the power source. If you were to disconnect the light bulb from the wires and touch the two wires together (don't do this) the power supply wire to the component would be grounded before the normal ground connection for the circuit.

Because grounding a wire from a power source makes a complete circuit—less the required component to use the power—this phenomenon is called a short circuit. Common causes are: broken insulation (exposing the metal wire to a metal part of the car or truck), or a shorted switch.

Some electrical components which require a large amount of current to operate also have a relay in their circuit. Since these circuits carry a large amount of current, the thickness

of the wire in the circuit (gauge size) is also greater. If this large wire were connected from the component to the control switch on the instrument panel, and then back to the component, a voltage drop would occur in the circuit. To prevent this potential drop in voltage, an electromagnetic switch (relay) is used. The large wires in the circuit are connected from the battery to one side of the relay, and from the opposite side of the relay to the component. The relay is normally open, preventing current from passing through the circuit. An additional, smaller, wire is connected from the relay to the control switch for the circuit. When the control switch is turned on, it grounds the smaller wire from the relay and completes the circuit. This closes the relay and allows current to flow from the battery to the component. The horn, headlight, and starter circuits are three which use relays.

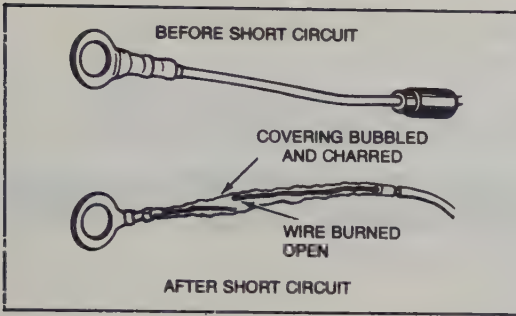
It is possible for larger surges of current to pass through the electrical system of your car or truck. If this surge of current were to reach an electrical component, it could burn it out. To prevent this, fuses, circuit breakers or fusible links are connected into the current supply wires of most of the major electrical systems. When an electrical current of excessive power passes through the component's fuse, the fuse blows out and breaks the circuit, saving the component from destruction.



Typical automotive fuse

A circuit breaker is basically a self-repairing fuse. The circuit breaker opens the circuit the same way a fuse does. However, when either the short is removed from the circuit or the surge subsides, the circuit breaker resets itself and does not have to be replaced as a fuse does.

A fuse link is a wire that acts as a fuse. It is normally connected between the starter relay and the main wiring harness. This connection is usually under the hood. The fuse link (if installed) protects all the



Most fusible links show a charred, melted insulation when they burn out

chassis electrical components, and is the probable cause of trouble when none of the electrical components function, unless the battery is disconnected or dead.

Electrical problems generally fall into one of three areas:

1. The component that is not functioning is not receiving current.
2. The component itself is not functioning.
3. The component is not properly grounded.

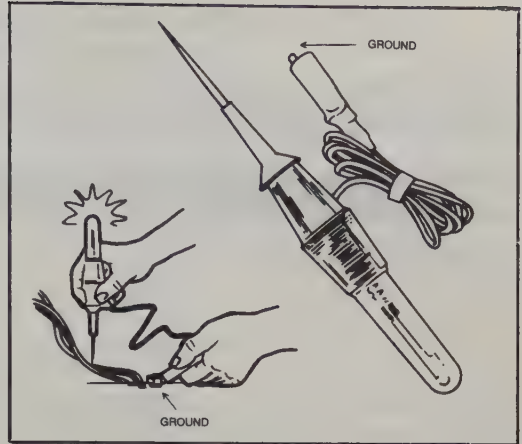
The electrical system can be checked with a test light and a jumper wire. A test light is a device that looks like a pointed screwdriver with a wire attached to it and has a light bulb in its handle. A jumper wire is a piece of insulated wire with an alligator clip attached to each end.

If a component is not working, you must follow a systematic plan to determine which of the three causes is the villain.

1. Turn on the switch that controls the inoperable component.
2. Disconnect the power supply wire from the component.
3. Attach the ground wire on the test light to a good metal ground.
4. Touch the probe end of the test light to the end of the power supply wire that was disconnected from the component. If the component is receiving current, the test light will go on.

NOTE: *Some components work only when the ignition switch is turned on.*

If the test light does not go on, then the problem is in the circuit between the battery and the component. This includes all the switches, fuses, and relays in the system. Follow the wire that runs back to the battery. The problem is an open circuit between the



The test light will show the presence of current when touched to a hot wire and grounded at the other end

battery and the component. If the fuse is blown and, when replaced, immediately blows again, there is a short circuit in the system which must be located and repaired. If there is a switch in the system, bypass it with a jumper wire. This is done by connecting one end of the jumper wire to the power supply wire into the switch and the other end of the jumper wire to the wire coming out of the switch. If the test light lights with the jumper wire installed, the switch or whatever was bypassed is defective.

NOTE: *Never substitute the jumper wire for the component, since it is required to use the power from the power source.*

5. If the bulb in the test light goes on, then the current is getting to the component that is not working. This eliminates the first of the three possible causes. Connect the power supply wire and connect a jumper wire from the component to a good metal ground. Do this with the switch which controls the component turned on, and also the ignition switch turned on if it is required for the component to work. If the component works with the jumper wire installed, then it has a bad ground. This is usually caused by the metal area on which the component mounts to the chassis being coated with some type of foreign matter.

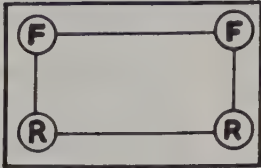
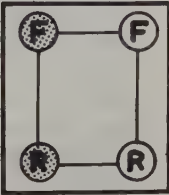
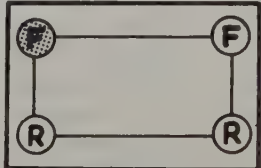
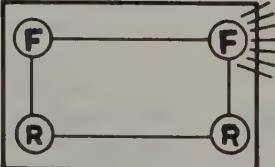
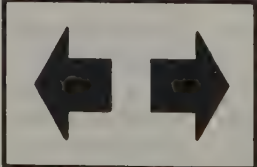
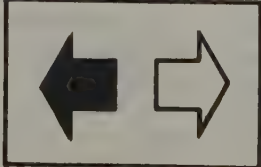
6. If neither test located the source of the trouble, then the component itself is defective. Remember that for any electrical system to work, all connections must be clean and tight.

Troubleshooting Basic Turn Signal and Flasher Problems

See Chapter 5 for service procedures

Most problems in the turn signals or flasher system can be reduced to defective flashers or bulbs, which are easily replaced. Occasionally, the turn signal switch will prove defective.

F = Front R = Rear ● = Lights off ○ = Lights on

Condition		Possible Cause
Turn signals light, but do not flash		Defective flasher
No turn signals light on either side		Blown fuse. Replace if defective. Defective flasher. Check by substitution. Open circuit, short circuit or poor ground.
Both turn signals on one side don't work		Bad bulbs. Bad ground in both (or either) housings.
One turn signal light on one side doesn't work		Defective bulb. Corrosion in socket. Clean contacts. Poor ground at socket.
Turn signal flashes too fast or too slowly		Check any bulb on the side flashing too fast. A heavy-duty bulb is probably installed in place of a regular bulb. Check the bulb flashing too slowly. A standard bulb was probably installed in place of a heavy-duty bulb. Loose connections or corrosion at the bulb socket.
Indicator lights don't work in either direction		Check if the turn signals are working. Check the dash indicator lights. Check the flasher by substitution.
One indicator light doesn't light		On systems with one dash indicator: See if the lights work on the same side. Often the filaments have been reversed in systems combining stoplights with tail-lights and turn signals. Check the flasher by substitution. On systems with two indicators: Check the bulbs on the same side. Check the indicator light bulb. Check the flasher by substitution.

Troubleshooting Lighting Problems

See Chapter 5 for service procedures

Condition	Possible Cause
One or more lights don't work, but others do	1. Defective bulb(s) 2. Blown fuse(s) 3. Dirty fuse clips or light sockets 4. Poor ground circuit
Lights burn out quickly	1. Incorrect voltage regulator setting or defective regulator 2. Poor battery/alternator connections
Lights go dim	1. Low/discharged battery 2. Alternator not charging 3. Corroded sockets or connections 4. Low voltage output
Lights flicker	1. Loose connection 2. Poor ground. (Run ground wire from light housing to frame) 3. Circuit breaker operating (short circuit)
Lights "flare"—Some flare is normal on acceleration—If excessive, see "Lights Burn Out Quickly"	High voltage setting
Lights glare—approaching drivers are blinded	1. Lights adjusted too high 2. Rear springs or shocks sagging 3. Rear tires soft

Troubleshooting Dash Gauge Problems

Most problems can be traced to a defective sending unit or faulty wiring. Occasionally, the gauge itself is at fault. See Chapter 5 for service procedures.

Condition	Possible Cause
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COOLANT TEMPERATURE GAUGE

Gauge reads erratically or not at all	1. Loose or dirty connections 2. Defective sending unit. 3. Defective gauge. To test a bi-metal gauge, remove the wire from the sending unit. Ground the wire for an instant. If the gauge registers, replace the sending unit. To test a magnetic gauge, disconnect the wire at the sending unit. With ignition ON gauge should register COLD. Ground the wire; gauge should register HOT.
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AMMETER GAUGE—TURN HEADLIGHTS ON (DO NOT START ENGINE). NOTE REACTION

Ammeter shows charge	1. Connections reversed on gauge
Ammeter shows discharge	2. Ammeter is OK
Ammeter does not move	3. Loose connections or faulty wiring
	4. Defective gauge

Condition	Possible Cause
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OIL PRESSURE GAUGE

Gauge does not register or is inaccurate	1. On mechanical gauge, Bourdon tube may be bent or kinked. 2. Low oil pressure. Remove sending unit. Idle the engine briefly. If no oil flows from sending unit hole, problem is in engine. 3. Defective gauge. Remove the wire from the sending unit and ground it for an instant with the ignition ON. A good gauge will go to the top of the scale. 4. Defective wiring. Check the wiring to the gauge. If it's OK and the gauge doesn't register when grounded, replace the gauge. 5. Defective sending unit.
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ALL GAUGES

All gauges do not operate	1. Blown fuse 2. Defective instrument regulator
All gauges read low or erratically	3. Defective or dirty instrument voltage regulator 4. Loss of ground between instrument voltage regulator and frame
All gauges pegged	5. Defective instrument regulator

WARNING LIGHTS

Light(s) do not come on when ignition is ON, but engine is not started	1. Defective bulb 2. Defective wire 3. Defective sending unit. Disconnect the wire from the sending unit and ground it. Replace the sending unit if the light comes on with the ignition ON.
Light comes on with engine running	4. Problem in individual system 5. Defective sending unit

Troubleshooting Clutch Problems

It is false economy to replace individual clutch components. The pressure plate, clutch plate and throwout bearing should be replaced as a set, and the flywheel face inspected, whenever the clutch is overhauled. See Chapter 6 for service procedures.

Condition	Possible Cause
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Clutch chatter	1. Grease on driven plate (disc) facing 2. Binding clutch linkage or cable 3. Loose, damaged facings on driven plate (disc) 4. Engine mounts loose 5. Incorrect height adjustment of pressure plate release levers 6. Clutch housing or housing to transmission adapter misalignment 7. Loose driven plate hub
Clutch grabbing	1. Oil, grease on driven plate (disc) facing 2. Broken pressure plate 3. Warped or binding driven plate. Driven plate binding on clutch shaft
Clutch slips	1. Lack of lubrication in clutch linkage or cable (linkage or cable binds, causes incomplete engagement) 2. Incorrect pedal, or linkage adjustment 3. Broken pressure plate springs 4. Weak pressure plate springs 5. Grease on driven plate facings (disc)

Troubleshooting Clutch Problems (cont.)

Condition	Possible Cause
Incomplete clutch release	1. Incorrect pedal or linkage adjustment or linkage or cable binding 2. Incorrect height adjustment on pressure plate release levers 3. Loose, broken facings on driven plate (disc) 4. Bent, dished, warped driven plate caused by overheating
Grinding, whirring grating noise when pedal is depressed	1. Worn or defective throwout bearing 2. Starter drive teeth contacting flywheel ring gear teeth. Look for milled or polished teeth on ring gear.
Squeal, howl, trumpeting noise when pedal is being released (occurs during first inch to inch and one-half of pedal travel)	Pilot bushing worn or lack of lubricant. If bushing appears OK, polish bushing with emery cloth, soak lube wick in oil, lube bushing with oil, apply film of chassis grease to clutch shaft pilot hub, reassemble. NOTE: Bushing wear may be due to misalignment of clutch housing or housing to transmission adapter
Vibration or clutch pedal pulsation with clutch disengaged (pedal fully depressed)	1. Worn or defective engine transmission mounts 2. Flywheel run out. (Flywheel run out at face not to exceed 0.005") 3. Damaged or defective clutch components

Troubleshooting Manual Transmission Problems

See Chapter 6 for service procedures

Condition	Possible Cause
Transmission jumps out of gear	1. Misalignment of transmission case or clutch housing. 2. Worn pilot bearing in crankshaft. 3. Bent transmission shaft. 4. Worn high speed sliding gear. 5. Worn teeth or end-play in clutch shaft. 6. Insufficient spring tension on shifter rail plunger. 7. Bent or loose shifter fork. 8. Gears not engaging completely. 9. Loose or worn bearings on clutch shaft or mainshaft. 10. Worn gear teeth. 11. Worn or damaged detent balls.
Transmission sticks in gear	1. Clutch not releasing fully. 2. Burred or battered teeth on clutch shaft, or sliding sleeve. 3. Burred or battered transmission mainshaft. 4. Frozen synchronizing clutch. 5. Stuck shifter rail plunger. 6. Gearshift lever twisting and binding shifter rail. 7. Battered teeth on high speed sliding gear or on sleeve. 8. Improper lubrication, or lack of lubrication. 9. Corroded transmission parts. 10. Defective mainshaft pilot bearing. 11. Locked gear bearings will give same effect as stuck in gear.
Transmission gears will not synchronize	1. Binding pilot bearing on mainshaft, will synchronize in high gear only. 2. Clutch not releasing fully. 3. Detent spring weak or broken. 4. Weak or broken springs under balls in sliding gear sleeve. 5. Binding bearing on clutch shaft, or binding countershaft. 6. Binding pilot bearing in crankshaft. 7. Badly worn gear teeth. 8. Improper lubrication. 9. Constant mesh gear not turning freely on transmission mainshaft. Will synchronize in that gear only.

Condition	Possible Cause
Gears spinning when shifting into gear from neutral	1. Clutch not releasing fully. 2. In some cases an extremely light lubricant in transmission will cause gears to continue to spin for a short time after clutch is released. 3. Binding pilot bearing in crankshaft.
Transmission noisy in all gears	1. Insufficient lubricant, or improper lubricant. 2. Worn countergear bearings. 3. Worn or damaged main drive gear or countergear. 4. Damaged main drive gear or mainshaft bearings. 5. Worn or damaged countergear anti-lash plate.
Transmission noisy in neutral only	1. Damaged main drive gear bearing. 2. Damaged or loose mainshaft pilot bearing. 3. Worn or damaged countergear anti-lash plate. 4. Worn countergear bearings.
Transmission noisy in one gear only	1. Damaged or worn constant mesh gears. 2. Worn or damaged countergear bearings. 3. Damaged or worn synchronizer.
Transmission noisy in reverse only	1. Worn or damaged reverse idler gear or idler bushing. 2. Worn or damaged mainshaft reverse gear. 3. Worn or damaged reverse countergear. 4. Damaged shift mechanism.

TROUBLESHOOTING AUTOMATIC TRANSMISSION PROBLEMS

Keeping alert to changes in the operating characteristics of the transmission (changing shift points, noises, etc.) can prevent small problems from becoming large ones. If the problem cannot be traced to loose bolts, fluid level, misadjusted linkage, clogged filters or similar problems, you should probably seek professional service.

Transmission Fluid Indications

The appearance and odor of the transmission fluid can give valuable clues to the overall condition of the transmission. Always note the appearance of the fluid when you check the fluid level or change the fluid. Rub a small amount of fluid between your fingers to feel for grit and smell the fluid on the dipstick.

<i>If the fluid appears:</i>	<i>It indicates:</i>
Clear and red colored	Normal operation
Discolored (extremely dark red or brownish) or smells burned	Band or clutch pack failure, usually caused by an overheated transmission. Hauling very heavy loads with insufficient power or failure to change the fluid often result in overheating. Do not confuse this appearance with newer fluids that have a darker red color and a strong odor (though not a burned odor).
Foamy or aerated (light in color and full of bubbles)	1. The level is too high (gear train is churning oil) 2. An internal air leak (air is mixing with the fluid). Have the transmission checked professionally.
Solid residue in the fluid	Defective bands, clutch pack or bearings. Bits of band material or metal abrasives are clinging to the dipstick. Have the transmission checked professionally.
Varnish coating on the dipstick	The transmission fluid is overheating

TROUBLESHOOTING DRIVE AXLE PROBLEMS

First, determine when the noise is most noticeable.

Drive Noise: Produced under vehicle acceleration.

Coast Noise: Produced while coasting with a closed throttle.

Float Noise: Occurs while maintaining constant speed (just enough to keep speed constant) on a level road.

External Noise Elimination

It is advisable to make a thorough road test to determine whether the noise originates in the rear axle or whether it originates from the tires, engine, transmission, wheel bearings or road surface. Noise originating from other places cannot be corrected by servicing the rear axle.

ROAD NOISE

Brick or rough surfaced concrete roads produce noises that seem to come from the rear axle. Road noise is usually identical in Drive or Coast and driving on a different type of road will tell whether the road is the problem.

TIRE NOISE

Tire noise can be mistaken as rear axle noise, even though the tires on the front are at fault. Snow tread and mud tread tires or tires worn unevenly will frequently cause vibrations which seem to originate elsewhere; *temporarily, and for test purposes only*, inflate the tires to 40–50 lbs. This will significantly alter the noise produced by the tires,

but will not alter noise from the rear axle. Noises from the rear axle will normally cease at speeds below 30 mph on coast, while tire noise will continue at lower tone as speed is decreased. The rear axle noise will usually change from drive conditions to coast conditions, while tire noise will not. Do not forget to lower the tire pressure to normal after the test is complete.

ENGINE/TRANSMISSION NOISE

Determine at what speed the noise is most pronounced, then stop in a quiet place. With the transmission in Neutral, run the engine through speeds corresponding to road speeds where the noise was noticed. Noises produced with the vehicle standing still are coming from the engine or transmission.

FRONT WHEEL BEARINGS

Front wheel bearing noises, sometimes confused with rear axle noises, will not change when comparing drive and coast conditions. While holding the speed steady, lightly apply the footbrake. This will often cause wheel bearing noise to lessen, as some of the weight is taken off the bearing. Front wheel bearings are easily checked by jacking up the wheels and spinning the wheels. Shaking the wheels will also determine if the wheel bearings are excessively loose.

REAR AXLE NOISES

Eliminating other possible sources can narrow the cause to the rear axle, which normally produces noise from worn gears or bearings. Gear noises tend to peak in a narrow speed range, while bearing noises will usually vary in pitch with engine speeds.

Noise Diagnosis

The Noise Is:

1. Identical under Drive or Coast
2. Different depending on road surface
3. Lower as speed is lowered
4. Similar when standing or moving
5. A vibration
6. A knock or click about every two tire revolutions
7. Most pronounced on turns
8. A steady low-pitched whirring or scraping, starting at low speeds
9. A chattering vibration on turns
10. Noticed only in Drive, Coast or Float conditions

Most Probably Produced By:

- Road surface, tires or front wheel bearings
- Road surface or tires
- Tires
- Engine or transmission
- Unbalanced tires, rear wheel bearing, unbalanced driveshaft or worn U-joint
- Rear wheel bearing
- Damaged differential gears
- Damaged or worn pinion bearing
- Wrong differential lubricant or worn clutch plates (limited slip rear axle)
- Worn ring gear and/or pinion gear

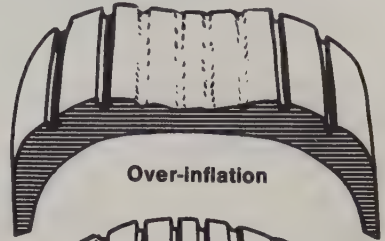
Troubleshooting Steering & Suspension Problems

Condition	Possible Cause
Hard steering (wheel is hard to turn)	1. Improper tire pressure 2. Loose or glazed pump drive belt 3. Low or incorrect fluid 4. Loose, bent or poorly lubricated front end parts 5. Improper front end alignment (excessive caster) 6. Bind in steering column or linkage 7. Kinked hydraulic hose 8. Air in hydraulic system 9. Low pump output or leaks in system 10. Obstruction in lines 11. Pump valves sticking or out of adjustment 12. Incorrect wheel alignment
Loose steering (too much play in steering wheel)	1. Loose wheel bearings 2. Faulty shocks 3. Worn linkage or suspension components 4. Loose steering gear mounting or linkage points 5. Steering mechanism worn or improperly adjusted 6. Valve spool improperly adjusted 7. Worn ball joints, tie-rod ends, etc.
Veers or wanders (pulls to one side with hands off steering wheel)	1. Improper tire pressure 2. Improper front end alignment 3. Dragging or improperly adjusted brakes 4. Bent frame 5. Improper rear end alignment 6. Faulty shocks or springs 7. Loose or bent front end components 8. Play in Pitman arm 9. Steering gear mountings loose 10. Loose wheel bearings 11. Binding Pitman arm 12. Spool valve sticking or improperly adjusted 13. Worn ball joints
Wheel oscillation or vibration transmitted through steering wheel	1. Low or uneven tire pressure 2. Loose wheel bearings 3. Improper front end alignment 4. Bent spindle 5. Worn, bent or broken front end components 6. Tires out of round or out of balance 7. Excessive lateral runout in disc brake rotor 8. Loose or bent shock absorber or strut
Noises (see also "Troubleshooting Drive Axle Problems")	1. Loose belts 2. Low fluid, air in system 3. Foreign matter in system 4. Improper lubrication 5. Interference or chafing in linkage 6. Steering gear mountings loose 7. Incorrect adjustment or wear in gear box 8. Faulty valves or wear in pump 9. Kinked hydraulic lines 10. Worn wheel bearings
Poor return of steering	1. Over-inflated tires 2. Improperly aligned front end (excessive caster) 3. Binding in steering column 4. No lubrication in front end 5. Steering gear adjusted too tight
Uneven tire wear (see "How To Read Tire Wear")	1. Incorrect tire pressure 2. Improperly aligned front end 3. Tires out-of-balance 4. Bent or worn suspension parts

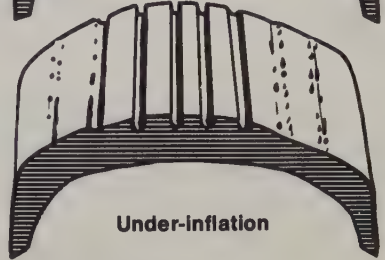
HOW TO READ TIRE WEAR

The way your tires wear is a good indicator of other parts of the suspension. Abnormal wear patterns are often caused by the need for simple tire maintenance, or for front end alignment.

Excessive wear at the center of the tread indicates that the air pressure in the tire is consistently too high. The tire is riding on the center of the tread and wearing it prematurely. Occasionally, this wear pattern can result from outrageously wide tires on narrow rims. The cure for this is to replace either the tires or the wheels.



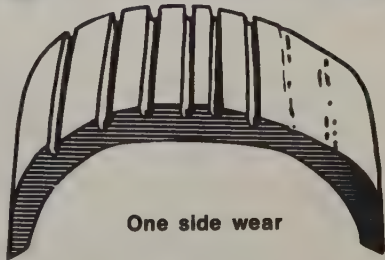
This type of wear usually results from consistent under-inflation. When a tire is under-inflated, there is too much contact with the road by the outer treads, which wear prematurely. When this type of wear occurs, and the tire pressure is known to be consistently correct, a bent or worn steering component or the need for wheel alignment could be indicated.



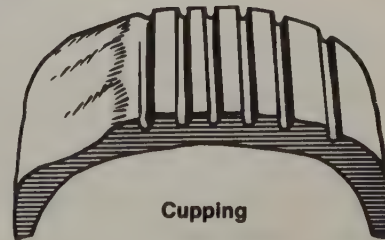
Feathering is a condition when the edge of each tread rib develops a slightly rounded edge on one side and a sharp edge on the other. By running your hand over the tire, you can usually feel the sharper edges before you'll be able to see them. The most common causes of feathering are incorrect toe-in setting or deteriorated bushings in the front suspension.



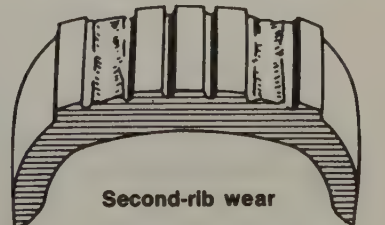
When an inner or outer rib wears faster than the rest of the tire, the need for wheel alignment is indicated. There is excessive camber in the front suspension, causing the wheel to lean too much putting excessive load on one side of the tire. Misalignment could also be due to sagging springs, worn ball joints, or worn control arm bushings. Be sure the vehicle is loaded the way it's normally driven when you have the wheels aligned.



Cups or scalloped dips appearing around the edge of the tread almost always indicate worn (sometimes bent) suspension parts. Adjustment of wheel alignment alone will seldom cure the problem. Any worn component that connects the wheel to the suspension can cause this type of wear. Occasionally, wheels that are out of balance will wear like this, but wheel imbalance usually shows up as bald spots between the outside edges and center of the tread.



Second-rib wear is usually found only in radial tires, and appears where the steel belts end in relation to the tread. It can be kept to a minimum by paying careful attention to tire pressure and frequently rotating the tires. This is often considered normal wear but excessive amounts indicate that the tires are too wide for the wheels.



Troubleshooting Disc Brake Problems

<i>Condition</i>	<i>Possible Cause</i>
Noise—groan—brake noise emanating when slowly releasing brakes (creep-groan)	Not detrimental to function of disc brakes—no corrective action required. (This noise may be eliminated by slightly increasing or decreasing brake pedal efforts.)
Rattle—brake noise or rattle emanating at low speeds on rough roads, (front wheels only).	1. Shoe anti-rattle spring missing or not properly positioned. 2. Excessive clearance between shoe and caliper. 3. Soft or broken caliper seals. 4. Deformed or misaligned disc. 5. Loose caliper.
Scraping	1. Mounting bolts too long. 2. Loose wheel bearings. 3. Bent, loose, or misaligned splash shield.
Front brakes heat up during driving and fail to release	1. Operator riding brake pedal. 2. Stop light switch improperly adjusted. 3. Sticking pedal linkage. 4. Frozen or seized piston. 5. Residual pressure valve in master cylinder. 6. Power brake malfunction. 7. Proportioning valve malfunction.
Leaky brake caliper	1. Damaged or worn caliper piston seal. 2. Scores or corrosion on surface of cylinder bore.
Grabbing or uneven brake action— Brakes pull to one side	1. Causes listed under "Brakes Pull". 2. Power brake malfunction. 3. Low fluid level in master cylinder. 4. Air in hydraulic system. 5. Brake fluid, oil or grease on linings. 6. Unmatched linings. 7. Distorted brake pads. 8. Frozen or seized pistons. 9. Incorrect tire pressure. 10. Front end out of alignment. 11. Broken rear spring. 12. Brake caliper pistons sticking. 13. Restricted hose or line. 14. Caliper not in proper alignment to braking disc. 15. Stuck or malfunctioning metering valve. 16. Soft or broken caliper seals. 17. Loose caliper.
Brake pedal can be depressed without braking effect	1. Air in hydraulic system or improper bleeding procedure. 2. Leak past primary cup in master cylinder. 3. Leak in system. 4. Rear brakes out of adjustment. 5. Bleeder screw open.
Excessive pedal travel	1. Air, leak, or insufficient fluid in system or caliper. 2. Warped or excessively tapered shoe and lining assembly. 3. Excessive disc runout. 4. Rear brake adjustment required. 5. Loose wheel bearing adjustment. 6. Damaged caliper piston seal. 7. Improper brake fluid (boil). 8. Power brake malfunction. 9. Weak or soft hoses.

Troubleshooting Disc Brake Problems (cont.)

Condition	Possible Cause
Brake roughness or chatter (pedal pumping)	1. Excessive thickness variation of braking disc. 2. Excessive lateral runout of braking disc. 3. Rear brake drums out-of-round. 4. Excessive front bearing clearance.
Excessive pedal effort	1. Brake fluid, oil or grease on linings. 2. Incorrect lining. 3. Frozen or seized pistons. 4. Power brake malfunction. 5. Kinked or collapsed hose or line. 6. Stuck metering valve. 7. Scored caliper or master cylinder bore. 8. Seized caliper pistons.
Brake pedal fades (pedal travel increases with foot on brake)	1. Rough master cylinder or caliper bore. 2. Loose or broken hydraulic lines/connections. 3. Air in hydraulic system. 4. Fluid level low. 5. Weak or soft hoses. 6. Inferior quality brake shoes or fluid. 7. Worn master cylinder piston cups or seals.

Troubleshooting Drum Brakes

Condition	Possible Cause
Pedal goes to floor	1. Fluid low in reservoir. 2. Air in hydraulic system. 3. Improperly adjusted brake. 4. Leaking wheel cylinders. 5. Loose or broken brake lines. 6. Leaking or worn master cylinder. 7. Excessively worn brake lining.
Spongy brake pedal	1. Air in hydraulic system. 2. Improper brake fluid (low boiling point). 3. Excessively worn or cracked brake drums. 4. Broken pedal pivot bushing.
Brakes pulling	1. Contaminated lining. 2. Front end out of alignment. 3. Incorrect brake adjustment. 4. Unmatched brake lining. 5. Brake drums out of round. 6. Brake shoes distorted. 7. Restricted brake hose or line. 8. Broken rear spring. 9. Worn brake linings. 10. Uneven lining wear. 11. Glazed brake lining. 12. Excessive brake lining dust. 13. Heat spotted brake drums. 14. Weak brake return springs. 15. Faulty automatic adjusters. 16. Low or incorrect tire pressure.

Condition	Possible Cause
Squealing brakes	1. Glazed brake lining. 2. Saturated brake lining. 3. Weak or broken brake shoe retaining spring. 4. Broken or weak brake shoe return spring. 5. Incorrect brake lining. 6. Distorted brake shoes. 7. Bent support plate. 8. Dust in brakes or scored brake drums. 9. Linings worn below limit. 10. Uneven brake lining wear. 11. Heat spotted brake drums.
Chirping brakes	1. Out of round drum or eccentric axle flange pilot.
Dragging brakes	1. Incorrect wheel or parking brake adjustment. 2. Parking brakes engaged or improperly adjusted. 3. Weak or broken brake shoe return spring. 4. Brake pedal binding. 5. Master cylinder cup sticking. 6. Obstructed master cylinder relief port. 7. Saturated brake lining. 8. Bent or out of round brake drum. 9. Contaminated or improper brake fluid. 10. Sticking wheel cylinder pistons. 11. Driver riding brake pedal. 12. Defective proportioning valve. 13. Insufficient brake shoe lubricant.
Hard pedal	1. Brake booster inoperative. 2. Incorrect brake lining. 3. Restricted brake line or hose. 4. Frozen brake pedal linkage. 5. Stuck wheel cylinder. 6. Binding pedal linkage. 7. Faulty proportioning valve.
Wheel locks	1. Contaminated brake lining. 2. Loose or torn brake lining. 3. Wheel cylinder cups sticking. 4. Incorrect wheel bearing adjustment. 5. Faulty proportioning valve.
Brakes fade (high speed)	1. Incorrect lining. 2. Overheated brake drums. 3. Incorrect brake fluid (low boiling temperature). 4. Saturated brake lining. 5. Leak in hydraulic system. 6. Faulty automatic adjusters.
Pedal pulsates	1. Bent or out of round brake drum.
Brake chatter and shoe knock	1. Out of round brake drum. 2. Loose support plate. 3. Bent support plate. 4. Distorted brake shoes. 5. Machine grooves in contact face of brake drum (Shoe Knock). 6. Contaminated brake lining. 7. Missing or loose components. 8. Incorrect lining material. 9. Out-of-round brake drums. 10. Heat spotted or scored brake drums. 11. Out-of-balance wheels.

Troubleshooting Drum Brakes (cont.)

Condition	Possible Cause
Brakes do not self adjust	1. Adjuster screw frozen in thread. 2. Adjuster screw corroded at thrust washer. 3. Adjuster lever does not engage star wheel. 4. Adjuster installed on wrong wheel.
Brake light glows	1. Leak in the hydraulic system. 2. Air in the system. 3. Improperly adjusted master cylinder pushrod. 4. Uneven lining wear. 5. Failure to center combination valve or proportioning valve.

Appendix

General Conversion Table

Multiply by	To convert	To	
2.54	Inches	Centimeters	.3937
30.48	Feet	Centimeters	.0328
.914	Yards	Meters	1.094
1.609	Miles	Kilometers	.621
.645	Square inches	Square cm.	.155
.836	Square yards	Square meters	1.196
16.39	Cubic inches	Cubic cm.	.061
28.3	Cubic feet	Liters	.0353
.4536	Pounds	Kilograms	2.2045
4.226	Gallons	Liters	.264
.068	Lbs./sq. in. (psi)	Atmospheres	14.7
.138	Foot pounds	Kg. m.	7.23
1.014	H.P. (DIN)	H.P. (SAE)	.9861
—	To obtain	From	Multiply by

Note: 1 cm. equals 10 mm.; 1 mm. equals .0394".

Conversion—Common Fractions to Decimals and Millimeters

Common Fractions	Decimal Fractions	Millimeters (approx.)	Common Fractions	Decimal Fractions	Millimeters (approx.)	Common Fractions	Decimal Fractions	Millimeters (approx.)
1/128	.008	0.20	11/32	.344	8.73	43/64	.672	17.07
1/64	.016	0.40	23/64	.359	9.13	11/16	.688	17.46
1/32	.031	0.79	3/8	.375	9.53	45/64	.703	17.86
3/64	.047	1.19	25/64	.391	9.92	23/32	.719	18.26
1/16	.063	1.59	13/32	.406	10.32	47/64	.734	18.65
5/64	.078	1.98	27/64	.422	10.72	3/4	.750	19.05
3/32	.094	2.38	7/16	.438	11.11	49/64	.766	19.45
7/64	.109	2.78	29/64	.453	11.51	25/32	.781	19.84
1/8	.125	3.18	15/32	.469	11.91	51/64	.797	20.24
9/64	.141	3.57	31/64	.484	12.30	13/16	.813	20.64
5/32	.156	3.97	1/2	.500	12.70	53/64	.828	21.03
11/64	.172	4.37	33/64	.516	13.10	27/32	.844	21.43
3/16	.188	4.76	17/32	.531	13.49	55/64	.859	21.83
13/64	.203	5.16	35/64	.547	13.89	7/8	.875	22.23
7/32	.219	5.56	9/16	.563	14.29	57/64	.891	22.62
15/64	.234	5.95	37/64	.578	14.68	29/32	.906	23.02
1/4	.250	6.35	19/32	.594	15.08	59/64	.922	23.42
17/64	.266	6.75	39/64	.609	15.48	15/16	.938	23.81
9/32	.281	7.14	5/8	.625	15.88	61/64	.953	24.21
19/64	.297	7.54	41/64	.641	16.27	31/32	.969	24.61
5/16	.313	7.94	21/32	.656	16.67	63/64	.984	25.00
21/64	.328	8.33						

Conversion—Millimeters to Decimal Inches

mm	inches	mm	inches	mm	inches	mm	inches	mm	inches
1	.039 370	31	1.220 470	61	2.401 570	91	3.582 670	210	8.267 700
2	.078 740	32	1.259 840	62	2.440 940	92	3.622 040	220	8.661 400
3	.118 110	33	1.299 210	63	2.480 310	93	3.661 410	230	9.055 100
4	.157 480	34	1.338 580	64	2.519 680	94	3.700 780	240	9.448 800
5	.196 850	35	1.377 949	65	2.559 050	95	3.740 150	250	9.842 500
6	.236 220	36	1.417 319	66	2.598 420	96	3.779 520	260	10.236 200
7	.275 590	37	1.456 689	67	2.637 790	97	3.818 890	270	10.629 900
8	.314 960	38	1.496 050	68	2.677 160	98	3.858 260	280	11.032 600
9	.354 330	39	1.535 430	69	2.716 530	99	3.897 630	290	11.417 300
10	.393 700	40	1.574 800	70	2.755 900	100	3.937 000	300	11.811 000
11	.433 070	41	1.614 170	71	2.795 270	105	4.133 848	310	12.204 700
12	.472 440	42	1.653 540	72	2.834 640	110	4.330 700	320	12.598 400
13	.511 810	43	1.692 910	73	2.874 010	115	4.527 550	330	12.992 100
14	.551 180	44	1.732 280	74	2.913 380	120	4.724 400	340	13.385 800
15	.590 550	45	1.771 650	75	2.952 750	125	4.921 250	350	13.779 500
16	.629 920	46	1.811 020	76	2.992 120	130	5.118 100	360	14.173 200
17	.669 290	47	1.850 390	77	3.031 490	135	5.314 950	370	14.566 900
18	.708 660	48	1.889 760	78	3.070 860	140	5.511 800	380	14.960 600
19	.748 030	49	1.929 130	79	3.110 230	145	5.708 650	390	15.354 300
20	.787 400	50	1.968 500	80	3.149 600	150	5.905 500	400	15.748 000
21	.826 770	51	2.007 870	81	3.188 970	155	6.102 350	500	19.685 000
22	.866 140	52	2.047 240	82	3.228 340	160	6.299 200	600	23.622 000
23	.905 510	53	2.086 610	83	3.267 710	165	6.496 050	700	27.559 000
24	.944 880	54	2.125 980	84	3.307 080	170	6.692 900	800	31.496 000
25	.984 250	55	2.165 350	85	3.346 450	175	6.889 750	900	35.433 000
26	1.023 620	56	2.204 720	86	3.385 820	180	7.086 600	1000	39.370 000
27	1.062 990	57	2.244 090	87	3.425 190	185	7.283 450	2000	78.740 000
28	1.102 360	58	2.283 460	88	3.464 560	190	7.480 300	3000	118.110 000
29	1.141 730	59	2.322 830	89	3.503 903	195	7.677 150	4000	157.480 000
30	1.181 100	60	2.362 200	90	3.543 300	200	7.874 000	5000	196.850 000

To change decimal millimeters to decimal inches, position the decimal point where desired on either side of the millimeter measurement shown and reset the inches decimal by the same number of digits in the same direction. For example, to convert 0.001 mm to decimal inches, reset the decimal behind the 1 mm (shown on the chart) to 0.001; change the decimal inch equivalent (0.039" shown) to 0.000039".

Tap Drill Sizes

Screw & Tap Size	National Fine or S.A.E. Threads Per Inch	Use Drill Number
No. 5	.44	.37
No. 6	.40	.33
No. 8	.36	.29
No. 10	.32	.21
No. 12	.28	.15
1/4	.28	3
5/16	.24	1
3/8	.24	Q
7/16	.20	W
1/2	.20	29/64
9/16	.18	33/64
5/8	.18	37/64
3/4	.16	11/16
7/8	.14	13/16
1 1/8	.12	13/64
1 1/4	.12	111/64
1 1/2	.12	127/64

Tap Drill Sizes

Screw & Tap Size	National Coarse or U.S.S. Threads Per Inch	Use Drill Number
No. 5	.40	.39
No. 6	.32	.36
No. 8	.32	.29
No. 10	.24	.25
No. 12	.24	.17
1/4	.20	8
5/16	.18	F
3/8	.16	5/16
7/16	.14	U
1/2	.13	27/64
9/16	.12	31/64
5/8	.11	17/32
3/4	.10	21/32
7/8	9	49/64
1	8	7/8
1 1/8	7	63/64
1 1/4	7	17/64
1 1/2	6	111/32

Decimal Equivalent Size of the Number Drills

<i>Drill No.</i>	<i>Decimal Equivalent</i>	<i>Drill No.</i>	<i>Decimal Equivalent</i>	<i>Drill No.</i>	<i>Decimal Equivalent</i>
80	.0135	53	.0595	26	.1470
79	.0145	52	.0635	25	.1495
78	.0160	51	.0670	24	.1520
77	.0180	50	.0700	23	.1540
76	.0200	49	.0730	22	.1570
75	.0210	48	.0760	21	.1590
74	.0225	47	.0785	20	.1610
73	.0240	46	.0810	19	.1660
72	.0250	45	.0820	18	.1695
71	.0260	44	.0860	17	.1730
70	.0280	43	.0890	16	.1770
69	.0292	42	.0935	15	.1800
68	.0310	41	.0960	14	.1820
67	.0320	40	.0980	13	.1850
66	.0330	39	.0995	12	.1890
65	.0350	38	.1015	11	.1910
64	.0360	37	.1040	10	.1935
63	.0370	36	.1065	9	.1960
62	.0380	35	.1100	8	.1990
61	.0390	34	.1110	7	.2010
60	.0400	33	.1130	6	.2040
59	.0410	32	.1160	5	.2055
58	.0420	31	.1200	4	.2090
57	.0430	30	.1285	3	.2130
56	.0465	29	.1360	2	.2210
55	.0520	28	.1405	1	.2280
54	.0550	27	.1440		

Decimal Equivalent Size of the Letter Drills

<i>Letter Drill</i>	<i>Decimal Equivalent</i>	<i>Letter Drill</i>	<i>Decimal Equivalent</i>	<i>Letter Drill</i>	<i>Decimal Equivalent</i>
A	.234	J	.277	S	.348
B	.238	K	.281	T	.358
C	.242	L	.290	U	.368
D	.246	M	.295	V	.377
E	.250	N	.302	W	.386
F	.257	O	.316	X	.397
G	.261	P	.323	Y	.404
H	.266	Q	.332	Z	.413
I	.272	R	.339		

Anti-Freeze Chart

Temperatures Shown in Degrees Fahrenheit +32 is Freezing

Cooling System Capacity Quarts	Quarts of ETHYLENE GLYCOL Needed for Protection to Temperatures Shown Below													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10	+24°	+16°	+ 4°	-12°	-34°	-62°								
11	+25	+18	+ 8	- 6	-23	-47								
12	+26	+19	+10	0	-15	-34	-57°							
13	+27	+21	+13	+ 3	- 9	-25	-45							
14			+15	+ 6	- 5	-18	-34							
15			+16	+ 8	0	-12	-26							
16			+17	+10	+ 2	- 8	-19	-34	-52°					
17			+18	+12	+ 5	- 4	-14	-27	-42					
18			+19	+14	+ 7	0	-10	-21	-34	-50°				
19			+20	+15	+ 9	+ 2	- 7	-16	-28	-42				
20				+16	+10	+ 4	- 3	-12	-22	-34	-48°			
21				+17	+12	+ 6	0	- 9	-17	-28	-41			
22				+18	+13	+ 8	+ 2	- 6	-14	-23	-34	-47°		
23				+19	+14	+ 9	+ 4	- 3	-10	-19	-29	-40		
24				+19	+15	+10	+ 5	0	- 8	-15	-23	-34	-46°	
25				+20	+16	+12	+ 7	+ 1	- 5	-12	-20	-29	-40	-50°
26					+17	+13	+ 8	+ 3	- 3	- 9	-16	-25	-34	-44
27					+18	+14	+ 9	+ 5	- 1	- 7	-13	-21	-29	-39
28					+18	+15	+10	+ 6	+ 1	- 5	-11	-18	-25	-34
29					+19	+16	+12	+ 7	+ 2	- 3	- 8	-15	-22	-29
30					+20	+17	+13	+ 8	+ 4	- 1	- 6	-12	-18	-25

For capacities over 30 quarts di-
vide true capacity by 3. Find quarts
Anti-Freeze for the 1/3 and multiply
by 3 for quarts to add.

For capacities under 10 quarts multiply true capacity by 3. Find quarts Anti-Freeze for the tripled volume and divide by 3 for quarts to add.

To Increase the Freezing Protection of Anti-Freeze Solutions Already Installed

Cooling System Capacity Quarts	Number of Quarts of ETHYLENE GLYCOL Anti-Freeze Required to Increase Protection															
	From +20° F. to					From +10° F. to					From 0° F. to					
	0°	-10°	-20°	-30°	-40°	0°	-10°	-20°	-30°	-40°	-10°	-20°	-30°	-40°		
10	1¾	2¼	3	3½	3¾	¾	1½	2¼	2¾	3¼	¾	1½	2	2½		
12	2	2¾	3½	4	4½	1	1¾	2½	3¼	3¾	1	1¾	2½	3¼		
14	2¼	3¼	4	4¾	5½	1¼	2	3	3¾	4½	1	2	3	3½		
16	2½	3½	4½	5¼	6	1½	2½	3½	4¼	5¼	1¼	2¼	3¼	4		
18	3	4	5	6	7	1½	2¾	4	5	5¾	1½	2½	3¾	4¾		
20	3¼	4½	5¾	6¾	7½	1¾	3	4¼	5½	6½	1½	2¾	4¼	5¼		
22	3½	5	6¼	7¼	8¼	1¾	3¼	4¾	6	7¼	1¾	3¼	4½	5½		
24	4	5½	7	8	9	2	3½	5	6½	7½	1¾	3½	5	6		
26	4¼	6	7½	8¾	10	2	4	5½	7	8¼	2	3¾	5½	6¾		
28	4½	6¼	8	9½	10½	2¼	4¼	6	7½	9	2	4	5¾	7¼		
30	5	6¾	8½	10	11½	2½	4½	6½	8	9½	2¼	4¼	6¼	7¾		

Test radiator solution with proper hydrometer. Determine from the table the number of quarts of solution to be drawn off from a full cooling system and replace with undiluted anti-freeze, to give the desired increased protection. For example, to increase protection of a 22-quart cooling system containing Ethylene Glycol (permanent type) anti-freeze, from +20° F. to -20° F. will require the replacement of 6¼ quarts of solution with undiluted anti-freeze.

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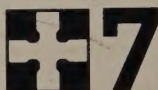
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